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DYNAMIC PROPERTIES OF MATERIALS

PART I. POLYMERS

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FOREWORD

This report describes the work performed by the Department of Aerospace Engineering, Boston University, for the Army Materials and Mechanics Research Center (AMMRC), Watertown, Massachusetts, under Contract No. DAAG-46-73-C-0181. The Contracting Officer Representative at AMMRC was Dr. S. C. Chou. The program was supervised by Professor M. M. Chen at Boston University.

Dynamic Properties of Polymers

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ABSTRACT

A survey of literature on the mechanical behavior of polymers subject to dynamic loads in a wide temperature range has been made. The data showing the variation of yield strength, and elongation with strain rates and temperatures were tabulated and plotted; the results obtained from tension and compression modes of loading are graphed separately. A comprehensive reference section is provided.

It is observed that the behavior of polymers under dynamic loading is different from static loading. The yield strengths are generally higher under dynamic loading than the static ones and they decrease with an increase of temperature.

INTRODUCTION

In the advent of recent advancement in plastic technology, various polymeric materials are being introduced into industrial and military use. Consequently, the precise knowledge

about their mechanical properties is highly desirable. The purpose of this survey is to obtain the experimental data on mechanical properties of polymers available in the literature, including the effects of strain rate and temperature. The pertinent data are compiled, converted if necessary, and plotted. This study is not intended as a critical review, but merely serves as a source of information on the dynamic properties of polymers.

The dynamic properties of polymers are highly dependent on strain rate and temperature. They have been studied, primarily in terms of the variance of yield strengths with strain rate. The general behavior of polymers may be classified in four distinct modes as shown in Fig. A and the yield strengths for each mode are as follows:

a) Brittle Modes - Brittle failure sets in before yielding (OF) - The yield stress is the failure load divided by the initial cross-sectional area.

b) Brittle-Ductile Mode - The yield stress is taken as the peak or maximum stress on the stress-strain curve. In this mode, the failure follows shortly after yielding (AF_1).

c) Ductile Mode - There are two yielding levels (AF_2). The yield stress is taken as the maximum stress on the stress-strain curve.

d) Homogeneous Mode - There is no typical yielding characteristic (AF_3). This mode seems to occur at high temperatures and in the region of glass transition

temperature for some materials (e.g., see L-2)*. In this case, the yield stress, B, is the stress obtained at the intersection of a 2% strain line parallel to the initial slope of the stress-strain curve (e.g., L-1).

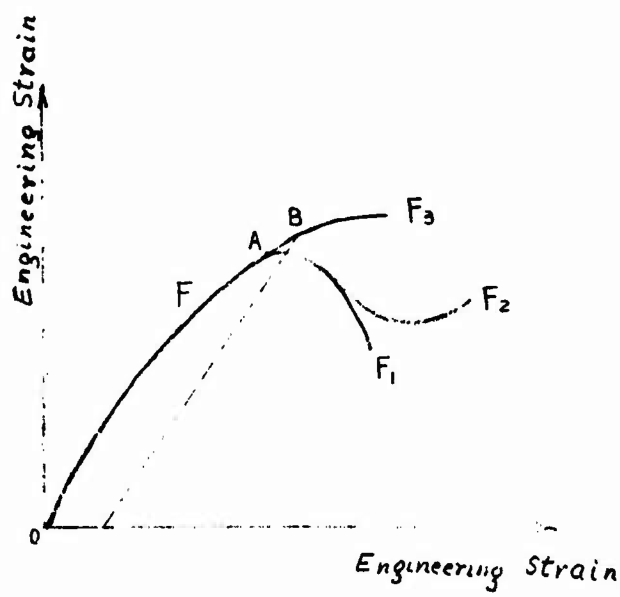

Figure A

In the tables of experimental results, the above four definitions were used when the yield stress was taken from the stress-strain curves. The method of measuring strain rate is identified in the remarks column whenever it is available. It should be noted that most of the tests conducted in this survey were at temperatures between -50° and 150°F.

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*Letter and number in the parenthesis indicates the reference number.

It is observed that in general, the yield strength, σ_y , varies linearly with log $\dot{\varepsilon}$, and that the slope of σ_y - log $\dot{\varepsilon}$ curve varies with the temperature. The interdependence of strain rate and temperature is often expressed as a "shift factor", a_T. The factor a_T implies the horizontal shift of the data points which represent the plot of yield strength versus strain rate at a temperature corresponding to the data points at reference temperature. The shift factor given by the Williams, Landel and Ferry (WLF) equation* in its modified form is:

$$\log a_T = -\frac{8.86\,(T - T_S)}{101.6 + T - T_S} \qquad (1)$$

where T_s denotes reference temperature and T_g is the glass transition temperature ($T_s = T_g + 50^\circ C$). Equation (1) is applicable for the temperature range between T_g and $T_g + 100^\circ C$. Outside this region, the shift factor of glassy and highly crystalline polymers is calculated from an equation of the Arrhenius form:

$$\log a_T = \frac{H_a}{R}\left(\frac{1}{T} - \frac{1}{T_0}\right) \qquad (2)$$

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*See, e.g., Ferry, J.D., Viscoelastic Properties of Polymers, John Wiley & Sons, Inc., New York, 1961.

where H_a is the activation energy for the particular transition of interest, $\bar{R}$ is universal gas constant, and T_0 is the temperature selected arbitrarily as reference. The Arrhenius equation is not used in the glass transition region because in this region, the activation energy is a strong function of temperature. When the rigidity of the molecular backbone reaches some limit, a new superposition procedure is needed which involves a vertical shift.

Using the shift factor, a_T, the major portion of the curve showing the relationship of the yield stress versus strain rate times a temperature dependent constant may be represented by an equation of the form:

$$\sigma_Y = K_1 + K_2 \, \ell n[(\dot{\varepsilon}/\dot{\varepsilon}_1) a_T] \qquad (3)$$

where σ_Y, $\dot{\varepsilon}$, and a_T are yield strength, strain rate and shift factor, respectively, K_1 and K_2 are constants which depend on the type of material and on the reference temperature, and $\dot{\varepsilon}_1$ is equal to 1 in/in/min.

RESULTS AND DISCUSSION

In this report, the test results obtained from tension, compression, and torsion modes of loading are, in most cases, plotted separately. The data are not only influenced by the mode of loading, but also are affected by the type apparatus used for the test. Properties may vary with specimen preparation such as heat treatment and the environment of testing

such as humidity, etc. It should be noted that the treatment of test results in the literature are generally not standardized. It was also shown that different data were obtained by different investigators for a similar test arrangement and material. This is partly due to the high degree of sensitivity exhibited by many plastics to the rate of strain and to their environmental conditions.

The elongation in tension tests is reported as the percentage of elongation at break. The experimental data listed in the tables, give both tension and compression as positive values.

For most data collected, the strain rate is held constant during the tests. However, when the strain rate is specified by any other method, the information is provided in the tables. If the strain rates are calculated from the cross-head speed, then the approximate strain rate is obtained by dividing the cross-head speed by the gage length. This approximation has been used for a maximum engineering strain of 20% (C-2).

In general, the dynamic yielding strengths are higher than the yielding strength under the static loads. They also decrease with an increase in temperature.

The List of Investigations summarizes the pertinent information obtained from the survey. Tables 1-9 provide the dynamic properties for various polymers and Figures 1-10 show the variation of yield strength vs. strain rate for a wide temperature range. Literature whose data were not used in the tabulation are listed in the Bibliography.

It is expected that this report be used as a source for quantitative information for design purposes and future research.

LIST OF INVESTIGATIONS

Material	T(°F)	$\dot{\varepsilon}$ (/sec)	Type of Test	Ref.	Date
PC (Makrolon Bayer)	70.7-284	$8.3x10^{-6}$-$2.1x10^{-1}$	tension	B-2	1969
PC (Makrolon Bayer)	212-311	$8.3x10^{-6}$-$2.1x10^{-1}$	tension	B-3	1969
PC (Makrolon Bayer)	-220-73.4	$4.16x10^{-5}$-$2.1x10^{-1}$	tension	B-4	1972
PC (Makrolon Bayer)	-193-257	$4.16x10^{-3}$	tension	B-4	1972
PC (Makrolon Bayer)	-193-257	$4.16x10^{-3}$	compression	B-4	1972
CAB(cellulose acetate butyrate)	72	$2x10^{-4}$-$1.05x10^{3}$	compression	C-2	1972
Lexan PC resin	73.4-302	$1.67x10^{-2}$,$1.67x10^{-1}$	tension	G-2	1963
PC	room	$8.3x10^{-1}$,$8.3x10^{1}$	tension	P-2	1963
PC (Zelux)	room	$2x10^{-3}$-$1.03x10^{3}$	compression	T-1	1963
PE	74.3	$3.3x10^{-4}$-$1.43x10^{2}$	tension	A-1	1960
PE (linear)	74.3	$3.3x10^{-4}$-$6.7x10^{-1}$	tension	A-1	1960
Amorophous PE terepthalate	74.3	$1.67x10^{-4}$-$3.3x10^{-1}$	tension	A-1	1960
Mylar C Polyster	74.3	$3.3x10^{-4}$-$1.54x10^{2}$	tension	A-1	1960
Mylar, Saran-coated	74.3	$3.3x10^{-4}$-$1.58x10^{2}$	tension	A-1	1960
PE (linear)	-166- -76	$5.25x10^{-2}$-$8.86x10^{2}$	torsion	B-1	1970
PE (high density)	-40--4	$5.25x10^{-2}$-$8.86x10^{2}$	torsion	B-1	1970
PE (branched) (low density)	-166-75.2	$1.05x10^{-1}$-$8.86x10^{2}$	torsion	B-1	1970
PE (type I-A)	70	$3.3x10^{-2}$-$7.3x10^{2}$	tension	D-1	1963
PE (type I-P)	70	$3.3x10^{-2}$-$6.5x10^{2}$	tension	D-1	1963
PE (type-II-A)	70	$4.17x10^{2}$-$8.17x10^{2}$	tension	D-1	1963
PE (type II-P)	70	$2.83x10^{2}$-$6.38x10^{2}$	tension	D-1	1963

Material	T(°F)	$\dot{\epsilon}$(/sec)	Type of Test	Ref.	Date
PE (Bakelite DYNH 1-3)	-58-158	$3.33\times10^{-4}-2.67\times10^{1}$	tension	E-1	1958
PE (Dupont Surlyn A)	-65-70	$8.5\times10^{-3}-4.58\times10^{-2}$	tension	J-1	1969
PE (high density)	room	$1.67\times10^{-4}-1.67\times10^{-1}$	tension	K-2	1973
PE (low density)	room	1.67×10^{-3}	tension	K-2	1973
PE (mylar terephthalate)	-34.6-266	$4.16\times10^{-5}-5.33\times10^{-2}$	tension	L-2	1965
PE film	room	$4.27\times10^{0}-8.67\times10^{1}$	tension	P-1	1961
PE (linear) (Marlex 50-Tape 40)	73.4	$3.3\times10^{-3}-3.3\times10^{1}$	tension	S-1	1964
PE (low density) (Monsanto 406)	73.4	$3.3\times10^{-3}-3.3\times10^{1}$	tension	S-1	1964
PE (high density)	73.4	$3.3\times10^{-3}-3.3\times10^{1}$	tension	S-1	1964
PE (high density)	room	$2.7\times10^{-3}-1\times10^{2}$	tension	W-1	1970
PE (low density)	room	$2.7\times10^{-3}-1\times10^{2}$	tension	W-1	1970
PEMA	95-176	$7.5\times10^{-6}-1.2\times10^{1}$	tension	R-2	1965
ABS	-40-140	$4.17\times10^{-3}-4.17\times10^{-1}$	tension	I-1	1970
ABS (lustran 461)	room	$4.5\times10^{-1}-2.08\times10^{1}$	tension	L-4	1963
PMMA (commercial I.C.I. Perspex)	-58,71.6,158	$2.5\times10^{-4}-1.6\times10^{-2}$	compression	B-5	1970
PMMA	72	$2\times10^{-4}-7.6\times10^{2}$	compression	C-2	1972
PMMA (Plexiglas)	104	$4.17\times10^{-4}-3.3\times10^{-3}$	tension	D-2	1948
Commercial Methyl Methacrylate	room	$5.14\times10^{-3}-3.15\times10^{0}$	compression	D-2	1948

Material	T(°F)	$\dot{\varepsilon}$(/sec)	Type of Test	Ref.	Date
Commercial Methyl Methacrylate	room	$4.23\times10^{-4}-5.73\times10^{-3}$	tension	D-2	1948
PMMA (plexiglas IA-UVA)	76	$5\times10^{-5}-1.83\times10^{1}$	tension	E-1	1958
PMMA (Commercial Plexiglas II)	32-239	$4.8\times10^{-5}-7.6\times10^{3}$	compression	H-3	1963
PMMA	-58-167	$1.67\times10^{-5}-1.67\times10^{-2}$	tension	K-1	1955
PMMA-G (Plexiglass G)	-68-239	$1.67\times10^{-4}-5\times10^{0}$	tension	L-2	1965
PMMA (Plexiglass UVA II)	-58-194	$4.83\times10^{-5}-4.83\times10^{-2}$	tension	L-3	1963
PMMA (Rohm & Haas Plexiglas)	74.8-185.5	3.3×10^{-3}	tension	M-1	1972
PMMA	32-122	$1.67\times10^{-5}-1.67\times10^{-2}$	tension	M-2	1952
PMMA	86-194	$8.4\times10^{-7}-2.9\times10^{0}$	tension	R-1	1965
Lucite(Methyl-Methacrylate)	room	$0-5.9\times10^{2}$	compression	T-1	1963
PS	74.3	$1.67\times10^{-2}-1.67\times10^{-1}$	tension	A-1	1960
PS (Atactic PS)	-350-71.6	$2.1\times10^{-4}-1.2\times10^{-2}$	compression	A-2	1968
PS (Amorphous Polystyrene)	68-176	$1.9\times10^{-4}-5\times10^{-2}$	compression	B-5	1970
PS (Atactic PS)	104-176	$6.7\times10^{-5}-6.7\times10^{-2}$	compression	B-6	1971
PS	73.4,125.6	$1.67\times10^{-5}-5.6\times10^{-2}$	tension	C-1	1952
PS	room	$1.67\times10^{-4}-1.67\times10^{-2}$	tension	D-2	1948
PS (Lustron)	room	$3.3\times10^{-5}-7.5\times10^{-3}$	tension	D-2	1948
Heat-resistant PS (lustrex)	room	$4\times10^{-5}-5.8\times10^{-3}$	tension	D-2	1948
GP-PS	-168-149	$1\times10^{-5}-1\times10^{-3}$	compression	H-2	1971

Material	T(°F)	$\dot{\epsilon}$(/sec)	Type of Test	Ref.	Date
PS	77	$1.19 \times 10^{-5} - 7.12 \times 10^{-4}$	compression	H-4	1951
High Impact PS (Styron 475s)	-40-104	$4.17 \times 10^{-3} - 4.17 \times 10^{-2}$	tension	I-1	1970
PS	-34.6-203	$1.1 \times 10^{-4} - 5 \times 10^{0}$	tension	L-2	1965
Rubber-modified PS (Lustrex HT 88-1)	room	$4.8 \times 10^{-1} - 2.33 \times 10^{1}$	tension	L-4	1963
PP (Atactic PP)	-148- -4	$5.25 \times 10^{-1} - 8.88 \times 10^{2}$	torsion	B-1	1970
PP	72	$2 \times 10^{-4} - 1.5 \times 10^{3}$	compression	C-2	1972
Isotactic PP	20-96	$3.3 \times 10^{-4} - 4.9 \times 10^{2}$	tension	H-1	1961
Isotactic PP	50-230	$7 \times 10^{-6} - 1 \times 10^{1}$	tension	R-3	1966
Crystalline PP (Profax)	73.4	$3.3 \times 10^{-3} - 3.3 \times 10^{1}$	tension	S-1	1964
PVC (Solvic 227)	-58-158	$8.33 \times 10^{-6} - 2.08 \times 10^{-1}$	tension	B-2	1969
""	122-185	$2.08 \times 10^{-5} - 2.08 \times 10^{-1}$	tension	B-3	1969
PVC-rubber blends (Geon 103 Ep)	-40-140	$4.16 \times 10^{-3} - 4.16 \times 10^{-1}$	tension	I-1	1970
PVC	-34.6-149	$5.83 \times 10^{-5} - 5 \times 10^{0}$	tension	L-2	1965
PVC	room	$8.33 \times 10^{-1} - 8.33 \times 10^{1}$	tension	P-2	1963
PVC (rigid) Type I	room	$2.7 \times 10^{-3} - 1 \times 10^{2}$	tension	W-1	1968
PVC Type II	room	$2.7 \times 10^{-3} - 1 \times 10^{2}$	tension	W-1	1968
PVC Type "1 1/2"	room	$2.7 \times 10^{-3} - 1 \times 10^{2}$	tension	W-1	1968
PVC Type I Special	room	$2.7 \times 10^{-3} - 1 \times 10^{2}$	tension	W-1	1968
PVC (hard) (Halvic 239)	-34.6-149	$8 \times 10^{-5} - 8.5 \times 10^{-2}$	tension	Z-1	1970
Nylon 6-6	72	$2 \times 10^{-3} - 1.25 \times 10^{3}$	compression	C-2	1972
Nylon-6(A)	-184-311	$5.5 \times 10^{-3} - 2.3 \times 10^{2}$	tension	G-1	1971

Material	T(°F)	$\dot{\varepsilon}$(/sec)	Type of Test	Ref.	Date
Nylon-6(E)	-184-311	$5.5\times10^{-3}, 2.3\times10^{2}$	tension	G-1	1971
Amorphous nylon (Dupont Zytel 63)	room	$1.43\times10^{-2}, 7.48\times10^{-2}$	tension	J-1	1969
Nylon(Dupont Type 101)	-148-302	$5\times10^{-4}-5\times10^{-1}$	tension	L-1	1965
Nylon	room	$2\times10^{-3}-8.6\times10^{2}$	compression	T-1	1963

TABLE 1 DYNAMIC PROPERTIES OF ACRYLONITRITE-BUTADIENE-STYRENE (ABS)

Material	T(°F)	$\dot{\varepsilon}$(/sec)	σ_Y(psi)	Elong. (%)	Ref.	Remarks
ABS	-40	4.17×10^{-3}	6910	27.3	I-1	Read from (σ_Y, Tension τ) curves
		4.17×10^{-2}	7440	19.3		
		4.17×10^{-1}	7460	18.2		
	-4	4.17×10^{-3}	6490	34.1		
		4.17×10^{-2}	6910	20.5		
		4.17×10^{-1}	7110	18.6		
	32	4.17×10^{-3}	5780	54.8		
		4.17×10^{-2}	6230	35.7		
		4.17×10^{-1}	6630	30.		
	68	4.17×10^{-3}	5030	29.5		
		4.17×10^{-2}	5400	53.4		
		4.17×10^{-1}	5780	41.1		
	104	4.17×10^{-3}	4380	12.5		
		4.17×10^{-2}	4730	23.9		
		4.17×10^{-1}	4850	50.		
	140	4.17×10^{-3}	3140	30.		
		4.17×10^{-2}	3650	44.3		
		4.17×10^{-1}	4100	58.		
ABS	room	4.5×10^{-1}	7330	17.6	L-4	Read from (σ_Y, Tension $\dot{\varepsilon}$) curve Lustran 461
		4.5×10^{0}	8050	15.3		
		2.08×10^{1}	8950	15.8		

TABLE 2 DYNAMIC PROPERTIES OF NYLON

Material	T(°F)	$\dot{\varepsilon}$(/sec)	σ_Y(psi)	Elong.	Ref.	Remarks
Nylon 6-6	72	2×10^{-3}	10200		C-2	2% offset
		2×10^{-2}	11100		Comp.	Read from (σ, ε)
		2×10^{-1}	13200			curves (true stress)
		3×10^{0}	13700			
		5×10^{1}	14600			
		1.25×10^{3}	21900			
Nylon-6	-184	5.5×10^{-3}	27600		G-1	Hyrosoluble content
	-148	5.5×10^{-3}	23900		Tension	1.5 wt% (A)
	-112	5.5×10^{-3}	22500			Read from (σ, ε) curves
		2.3×10^{2}	29900			Polycaprolactam
	-76	5.5×10^{-3}	20800			All specimens were obtained by injection
		2.3×10^{2}	28400			molding at a mold temp. 176°F, oven
	-58	5.5×10^{-3}	19900			conditioned in vacuo
	-40	5.5×10^{-3}	18800			at 140°F for 48 hrs. & stored in vacuo
		2.3×10^{2}	26800			over CaCl2 at 77°F
	-22	5.5×10^{-3}	17650			
	-4	5.5×10^{-3}	17050			
		2.3×10^{2}	23800			
	32	5.5×10^{-3}	15350			
		2.3×10^{2}	21600			
	73.4	5.5×10^{-3}	13080			
		2.3×10^{2}	18200			
	104	5.5×10^{-3}	10800			
		2.3×10^{2}	15800			
	122	5.5×10^{-3}	7550			
	140	5.5×10^{-3}	5700			
		2.3×10^{2}	11680			
	176	5.5×10^{-3}	3990			
		2.3×10^{2}	7900			
	212	5.5×10^{-3}	3390			
		2.3×10^{2}	5220			
	248	2.3×10^{2}	3670			
	311	2.3×10^{2}	2830			

Material	T(°F)	$\dot{\epsilon}$(/sec)	σ_Y(psi)	Elong.	Ref.	Remarks
Nylon-6	-166	5.5×10^{-3}	25400		G-1 Tension	Read from (σ, ϵ) curve Hydrosoluble content 8.8 wt% (E)
	-130	5.5×10^{-3}	23000			
	-101.2	5.5×10^{-3}	21170			
	-40	5.5×10^{-3}	17500			
		2.3×10^{2}	25150			
	-4	5.5×10^{-3}	15650			
		2.3×10^{2}	22300			
	32	5.5×10^{-3}	11900			
		2.3×10^{2}	21600			
	73.4	5.5×10^{-3}	7550			
		2.3×10^{2}	18200			
	104	5.5×10^{-3}	6250			
		2.3×10^{2}	15900			
	140	5.5×10^{-3}	3840			
		2.3×10^{2}	11400			
	176	2.3×10^{2}	7550			
	212	5.5×10^{-3}	2850			
		2.3×10^{2}	5400			
	248	2.3×10^{2}	3550			
	311	2.3×10^{2}	2770			
Amorphous Nylon	room	1.4×10^{-2}	20000		J-1 Tension	Read from (σ, ϵ) curve Dupont Zytel 63 (2% effect)
		3.6×10^{-2}	27000			
		7.5×10^{-2}	31000			
Nylon	-148	5×10^{-4}	23300		L-1 Tension	Read from curves (master curves)
		5×10^{-3}	23400			
		5×10^{-2}	25780			
		5×10^{-1}	23300			
	-103	5×10^{-4}	20400			
		5×10^{-3}	21740			
		5×10^{-2}	22200			
		5×10^{-1}	24700			
	-58	5×10^{-4}	16500			
		5×10^{-3}	17200			
		5×10^{-2}	22570			
		5×10^{-1}	20740			

Material	T(°F)	$\dot{\varepsilon}$(/sec)	σ_Y(psi)	Elong.	Ref.	Remarks
	-13	$5x10^{-4}$	13570			
		$5x10^{-3}$	14350			
		$5x10^{-2}$	15650			
		$5x10^{-1}$	16700			
	32	$5x10^{-4}$	3700			
		$5x10^{-3}$	10600			
		$5x10^{-2}$	12000			
		$5x10^{-1}$	12830			
	77	$5x10^{-4}$	4000			
		$5x10^{-3}$	5500			
		$5x10^{-2}$	7170			
		$5x10^{-1}$	6900			
	122	$5x10^{-4}$	2960			
		$5x10^{-3}$	3550			
		$5x10^{-2}$	3740			
		$5x10^{-1}$	4600			
	212	$5x10^{-4}$	2350			
		$5x10^{-3}$	2700			
		$5x10^{-2}$	3090			
		$5x10^{-1}$	3650			
	302	$5x10^{-4}$	1950			
		$5x10^{-3}$	2300			
		$5x10^{-2}$	2650			
		$5x10^{-1}$	3100			
Nylon	room	$2x10^{-3}$	13900		T-1 Comp.	Read from curves (σ, ε) 2% offset
		$5x10^{2}$	18900			(Polyamide)
		$8.6x10^{2}$	23900			$\dot{\varepsilon}$ = mean strain rate

TABLE 3 DYNAMIC PROPERTIES OF POLYCARBONATE (PC)

Material	T(°F)	$\dot{\varepsilon}$(/sec)	σ_Y(psi)	Elong. (%)	Ref.	Remarks
PC	70.7	8.3×10^{-6}	8060		B-2	Read from (σ_Y,
		2.1×10^{-5}	8170		Tension	$\dot{\varepsilon}$) curves
		4.2×10^{-5}	8380			Makrolon Bayer
		8.3×10^{-5}	8380			$\dot{\varepsilon}$ is calculated
		2.1×10^{-4}	8620			from crosshead
		4.2×10^{-4}	8730			speed
		8.3×10^{-4}	8920			
		2.1×10^{-3}	8980			
		4.2×10^{-3}	9080			
		8.3×10^{-3}	9270			
		2.1×10^{-2}	9460			
		4.2×10^{-2}	9560			
		8.3×10^{-2}	9700			
		2.1×10^{-1}	9770			
	104	8.3×10^{-6}	7280			
		2.1×10^{-5}	7390			
		4.2×10^{-5}	7440			
		8.3×10^{-5}	7560			
		2.1×10^{-4}	7680			
		4.2×10^{-4}	7820			
		8.3×10^{-4}	7920			
		2.1×10^{-3}	8100			
		4.2×10^{-3}	8110			
		8.3×10^{-3}	8460			
		2.1×10^{-2}	8460			
		4.2×10^{-2}	8470			
		8.3×10^{-2}	8740			
		2.1×10^{-1}	8900			
	140	8.3×10^{-6}	6260			
		2.1×10^{-5}	6490			
		4.2×10^{-5}	6430			
		8.3×10^{-5}	6740			
		2.1×10^{-4}	6700			

Material	T(°F)	$\dot{\epsilon}$(/sec)	σ_Y(psi)	Elong. (%)	Ref.	Remarks
		$4.2x10^{-4}$	6830			
		$8.3x10^{-4}$	7030			
		$2.1x10^{-3}$	7190			
		$4.2x10^{-3}$	7310			
		$8.3x10^{-3}$	7460			
		$2.1x10^{-2}$	7640			
		$4.2x10^{-2}$	7870			
		$8.3x10^{-2}$	7910			
		$2.1x10^{-1}$	8020			
	176	$8.3x10^{-6}$	5420			
		$2.1x10^{-5}$	5560			
		$4.2x10^{-5}$	5560			
		$8.3x10^{-5}$	5850			
		$2.1x10^{-4}$	5990			
		$4.2x10^{-4}$	6020			
		$8.3x10^{-4}$	6280			
		$2.1x10^{-3}$	6480			
		$4.2x10^{-3}$	6480			
		$8.3x10^{-3}$	6710			
		$2.1x10^{-2}$	6880			
		$4.2x10^{-2}$	6960			
		$8.3x10^{-2}$	7240			
		$2.1x10^{-1}$	7290			
	212	$2.1x10^{-5}$	4390			
		$4.2x10^{-5}$	4450			
		$8.3x10^{-5}$	4500			
		$2.1x10^{-4}$	4680			
		$4.2x10^{-4}$	5080			
		$8.3x10^{-4}$	5180			
		$2.1x10^{-3}$	5300			
		$4.2x10^{-3}$	5530			
		$8.3x10^{-3}$	5730			
		$2.1x10^{-2}$	6010			
		$4.2x10^{-2}$	6180			
		$8.3x10^{-2}$	6260			
		$2.1x10^{-1}$	6350			

Material	T(°F)	$\dot{\varepsilon}$(/sec)	σ_Y(psi)	Elong. (%)	Ref.	Remarks
	248	2.1×10^{-3}	4520			
		4.2×10^{-3}	4810			
		8.3×10^{-3}	4980			
		2.1×10^{-2}	5140			
		4.2×10^{-2}	5530			
		8.3×10^{-2}	5530			
		2.1×10^{-1}	5680			
	284	4.2×10^{-2}	4360			
		8.3×10^{-2}	4600			
		2.1×10^{-1}	4640			
PC	212	8.3×10^{-6}	4240		B-3	Read from (σ_Y,
		2.1×10^{-5}	4520		Tension	$\dot{\varepsilon}$) curves
		4.2×10^{-5}	4670			Makrolon Bayer
		8.3×10^{-5}	4730			Max stress = σ_Y
		2.1×10^{-4}	4940			$\dot{\varepsilon}$ is calculated
		4.2×10^{-4}	5300			from crosshead
		8.3×10^{-4}	5350			speed
		2.1×10^{-3}	5560			
		4.2×10^{-3}	5790			
		8.3×10^{-3}	6090			
		2.1×10^{-2}	6250			
		4.2×10^{-2}	6480			
		8.3×10^{-2}	6610			
		2.1×10^{-1}	6700			
	248	8.3×10^{-6}	2790			
		2.1×10^{-5}	2900			
		4.2×10^{-5}	3150			
		8.3×10^{-5}	3230			
		2.1×10^{-4}	3730			
		4.2×10^{-4}	3860			
		8.3×10^{-4}	4180			
		2.1×10^{-3}	4840			
		4.2×10^{-3}	5030			
		8.3×10^{-3}	5160			
		2.1×10^{-2}	5390			
		4.2×10^{-2}	5660			

Material	T(°F)	$\dot{\varepsilon}$(/sec)	σ_Y(psi)	Elong. (%)	Ref.	Remarks
		8.3×10^{-2}	5750			
		2.1×10^{-1}	5840			
	284	8.3×10^{-6}	490			
		2.1×10^{-5}	770			
		4.2×10^{-5}	1060			
		8.3×10^{-5}	1170			
		2.1×10^{-4}	2150			
		4.2×10^{-4}	2250			
		8.3×10^{-4}	2560			
		2.1×10^{-3}	2920			
		4.2×10^{-3}	3470			
		8.3×10^{-3}	3800			
		2.1×10^{-2}	4130			
		4.2×10^{-2}	4500			
		8.3×10^{-2}	4810			
		2.1×10^{-1}	4940			
	293	4.2×10^{-4}	590			
		8.3×10^{-4}	780			
		2.1×10^{-3}	1190			
		4.2×10^{-3}	1580			
		8.3×10^{-3}	1940			
		2.1×10^{-2}	2570			
		4.2×10^{-2}	2780			
		8.3×10^{-2}	3230			
		2.1×10^{-1}	3570			
	302	4.2×10^{-3}	380			
		8.3×10^{-3}	510			
		2.1×10^{-2}	750			
		4.2×10^{-2}	1000			
		8.3×10^{-2}	1440			
		2.1×10^{-1}	2000			
	311	2.1×10^{-2}	180			
		4.2×10^{-2}	230			
		8.3×10^{-2}	480			
		2.1×10^{-1}	960			

Material	T(°F)	$\dot{\varepsilon}$(/sec)	σ_Y(psi)	Elong. (%)	Ref.	Remarks
		4.2×10^{-4}	14600			
		8.3×10^{-4}	14500			
		2.1×10^{-3}	14800			
		4.2×10^{-3}	15400			
		8.3×10^{-3}	15200			
		2.1×10^{-2}	15700			
		4.2×10^{-2}	16300			
		8.3×10^{-2}	16600			
		2.1×10^{-1}	16700			
	-58	4.2×10^{-5}	11500			
		4.2×10^{-4}	12700			
		4.2×10^{-3}	12700			
		4.2×10^{-2}	13100			
		2.1×10^{-1}	13600			
	73.4	4.2×10^{-5}	8420			
		4.2×10^{-4}	8690			
		4.2×10^{-3}	9510			
		4.2×10^{-2}	9520			
		2.1×10^{-1}	10000			
	-193	4.2×10^{-3}	14900		B-4	Read from (σ_Y,
	-148	4.2×10^{-3}	14700		Tension	T) curve Tension
	-103	4.2×10^{-3}	14200			Makrolon Bayer Max stress = σ_Y
	-58	4.2×10^{-3}	13000			$\dot{\varepsilon}$ is calculated from crosshead
	-13	4.2×10^{-3}	11800			speed
	32	4.2×10^{-3}	10700			
	77	4.2×10^{-3}	9600			
	122	4.2×10^{-3}	8300			

Material	T(°F)	$\dot{\varepsilon}$(/sec)	σ_Y(psi)	Elong. (%)	Ref.	Remarks
PC	-220	4.2×10^{-4}	19900		B-4 Tension	Read from (σ_Y, $\dot{\varepsilon}$) curves (Tension) Makrolon Bayer Max stress = σ_Y $\dot{\varepsilon}$ is calculated from crosshead speed
		8.3×10^{-4}	20100			
		2.1×10^{-3}	20200			
		4.2×10^{-3}	20200			
		8.3×10^{-3}	20400			
		2.1×10^{-2}	20500			
		4.2×10^{-2}	21100			
		8.3×10^{-2}	21000			
		2.1×10^{-1}	21000			
	-193	4.2×10^{-5}	16900			
		8.3×10^{-5}	17500			
		2.1×10^{-4}	18000			
		4.2×10^{-4}	17700			
		8.3×10^{-4}	18000			
		2.1×10^{-3}	17700			
		4.2×10^{-3}	18400			
		8.3×10^{-3}	18700			
		2.1×10^{-2}	19200			
		4.2×10^{-2}	19900			
		8.3×10^{-2}	19600			
		2.1×10^{-1}	19600			
	-166	4.2×10^{-5}	15500			
		8.3×10^{-5}	15800			
		2.1×10^{-4}	15800			
		4.2×10^{-4}	15800			
		8.3×10^{-4}	16500			
		2.1×10^{-3}	16600			
		4.2×10^{-3}	17500			
		8.3×10^{-3}	17900			
		2.1×10^{-2}	17700			
		4.2×10^{-2}	18000			
		8.3×10^{-2}	17800			
		2.1×10^{-1}	18600			
	-130	4.2×10^{-5}	14500			
		8.3×10^{-5}	14500			
		2.1×10^{-4}	14600			

Material	T(°F)	$\dot{\varepsilon}$(/sec)	σ_Y(psi)	Elong. (%)	Ref.	Remarks
	167	4.2×10^{-3}	7200			
	212	4.2×10^{-3}	6200			
	257	4.2×10^{-3}	5000			
	-193	4.2×10^{-3}	30900		B-4 Comp.	Read from (σ_Y, T) curves Compression Makrolon Bayer Max stress = σ_Y $\dot{\varepsilon}$ is calculated from crosshead speed
	-148	4.2×10^{-3}	25800			
	-103	4.2×10^{-3}	20400			
	-58	4.2×10^{-3}	17400			
	-13	4.2×10^{-3}	15300			
	32	4.2×10^{-3}	13600			
	77	4.2×10^{-3}	12500			
	122	4.2×10^{-3}	10800			
	167	4.2×10^{-3}	9500			
	212	4.2×10^{-3}	7820			
	257	4.2×10^{-3}	6220			
PC	72	2×10^{-4}	4000		C-2 Comp.	Read from (σ , ε) curves (True Stress) (Max stress = σ_Y)
		2×10^{-3}	5000			
		2×10^{-2}	5300			
		2×10^{-1}	6880			
		4	8000			
		4x10	9780			
		$1.05\times10^{+3}$	15000			
Lexan PC Resin	73.4	1.67×10^{-2}	8850		G-2 Tension	Read from (σ_Y, T) curves strain rate = loading speed/ gage length
		1.67×10^{-1}	9850			
	122	1.67×10^{-2}	7860			
		1.67×10^{-1}	8700			
	194	1.67×10^{-2}	6300			

Material	T(°F)	$\dot{\epsilon}$(/sec)	σ_Y(psi)	Elong. (%)	Ref.	Remarks
		1.67×10^{-1}	6800			
	212	1.67×10^{-2}	6280			
		1.67×10^{-1}	6800			
	230	1.67×10^{-2}	6230			
		1.67×10^{-1}	6760			
	248	1.67×10^{-2}	6050			
		1.67×10^{-1}	6690			
	257	1.67×10^{-2}	5750			
		1.67×10^{-1}	6300			
	284	1.67×10^{-2}	5550			
		1.67×10^{-1}	6420			
	302	1.67×10^{-2}	4380			
		1.67×10^{-1}	5740			
PC	room	8.31×10^{-1}	9800	59.5	P-2 Tension	Strain rate = speed/jaw separation
		83.3×10^{1}	11200	43.7		
PC	room	2×10^{-3}	12000		T-1 Comp.	Read from (σ , ϵ) curves (Zelux)
		4.85×10^{2}	17200			
		6.93×10^{2}	18400			$\dot{\epsilon}$ = mean strain rate
		1.028×10^{3}	18800			

TABLE 4 DYNAMIC PROPERTIES OF POLYETHYLENE (PE)

Material	T(°F)	$\dot{\epsilon}$(/sec)	σ_Y(psi)	Elong. (%)	Ref.	Remarks
PE	74.3	3.3×10^{-4}	930		A-1 Tension	50% R.H.
		1.67×10^{-4}	1000			
		1.67×10^{-2}	1100	260		
		8.3×10^{-2}	1400	290		
		3.33×10^{1}		220		
		6.67×10^{1}		210		
		1.43×10^{3}		210		
PE(linear)	74.3	3.3×10^{-4}	1500			
		1.67×10^{-3}	1800			
		1.67×10^{-2}	2100	550		
		1.67×10^{-1}	2800	480		
		3.3×10^{-1}	3400	590		
		6.7×10^{-1}		10		
Amorophous PE tereph- thalate	74.3	1.7×10^{-4}	7000			
		1.67×10^{-3}	7700	390		
		1.67×10^{-2}	7800	460		
		8.3×10^{-2}	7600	5		
		1.67×10^{-1}		5		
		3.3×10^{-1}		10		
Mylar	74.3	3.3×10^{-4}	11800	70	A-1 Tension	Mylar C polyester Film 50% R.H.
		1.67×10^{-3}	12600	100		
		1.67×10^{-2}	13700	90		
		8.3×10^{-2}	14200	90		

Material	T(°F)	$\dot{\varepsilon}$(/sec)	σ_Y(psi)	Elong. (%)	Ref.	Remarks
		1.67×10^{-1}	15600	80		
		3.3×10^{-1}		120		
		7.7×10^{1}		110		
		1.54×10^{2}		130		
Mylar	74.3	3.3×10^{-4}	9200	120		Mylar, Saran-coated 50% R.H.
		1.67×10^{-3}	9700	130		
		1.67×10^{-2}	10400	110		
		8.3×10^{-2}	11200	120		
		1.67×10^{-1}	11300	140		
		1.33×10^{0}		110		
		1.58×10^{2}		100		
PE(linear)	-166	5.25×10^{-1}	5870		B-1 Torsion	Read from (σ_Y, $\dot{\varepsilon}$) curves effective strain rate
		3.36×10^{0}	6130			
		2.4×10^{1}	6350			
		1.1×10^{2}	6720			
		8.86×10^{2}	8250			
	-148	5.25×10^{-1}	5440			
		3.36×10^{0}	5770			
		2.39×10^{1}	6000			
		1.10×10^{2}	6530			
		8.86×10^{2}	8080			
	-112	5.25×10^{-1}	4810			
		3.36×10^{0}	5150			
		2.39×10^{1}	5440			
		1.10×10^{2}	6130			
		8.86×10^{2}	7830			

Material	T(°F)	$\dot{\varepsilon}$(/sec)	σ_Y(psi)	Elong. (%)	Ref.	Remarks
	-94	5.25×10^{-1}	4550			
		3.36×10^{0}	4800			
		2.39×10^{1}	5180			
		1.10×10^{2}	5830			
		8.86×10^{2}	7440			
	-76	5.25×10^{-1}	4240			
		3.36×10^{0}	4500			
		2.39×10^{1}	4890			
		1.10×10^{2}	5440			
		8.86×10^{2}	7160			
PE(high density)	-40	5.25×10^{-1}	3730			
		3.36×10^{0}	4070			
		2.39×10^{1}	4460			
		1.10×10^{2}	5070			
		8.86×10^{2}	6680			
	-4	5.25×10^{-1}	3370			
		3.36×10^{0}	3660			
		2.39×10^{1}	3870			
		1.10×10^{2}	4820			
		8.86×10^{2}	5890			
PE(branched) (low density)						
	-166	1.05×10^{-1}	4090		B-1 Torsion	Read from (σ_Y, $\dot{\varepsilon}$) curves effective strain rate
		5.25×10^{-1}	4250			
		3.36×10^{0}	4680			
		2.39×10^{1}	5270			
		1.10×10^{2}	5700			

Material	T(°F)	$\dot{\epsilon}$(/sec)	σ_Y(psi)	Elong. (%)	Ref.	Remarks
		8.86×10^{2}	6060			
	-130	1.05×10^{-1}	3890			
		5.25×10^{-1}	4000			
		3.36×10^{0}	4390			
		2.39×10^{1}	4880			
		1.10×10^{2}	5350			
		8.86×10^{2}	6000			
	-76	1.05×10^{-1}	3200			
		5.25×10^{-1}	3350			
		3.36×10^{0}	3740			
		2.39×10^{1}	4000			
		1.10×10^{2}	4350			
		8.86×10^{2}	4970			
	-22	1.05×10^{-1}	2390			
		5.25×10^{-1}	2400			
		3.36×10^{0}	2670			
		2.39×10^{1}	2900			
		1.10×10^{2}	3250			
		8.86×10^{2}	3640			
	-4	1.05×10^{-1}	2090			
		5.25×10^{-1}	2130			
		3.36×10^{0}	2340			
		2.39×10^{1}	2630			
		1.10×10^{2}	2850			
		8.86×10^{2}	3250			
	32	1.05×10^{-1}	1780			
		5.25×10^{-1}	1770			

Material	T(°F)	$\dot{\epsilon}$(/sec)	σ_Y(psi)	Elong. (%)	Ref	Remarks
		3.36×10^{0}	1850			
		2.39×10^{1}	2020			
		1.10×10^{2}	2260			
		8.86×10^{2}	2420			
	75.2	1.05×10^{-1}	1310			
		5.25×10^{-1}	1440			
		3.36×10^{0}	1490			
		2.39×10^{1}	1620			
		1.10×10^{2}	1840			
		8.86×10^{2}	2000			
PE(Type I-A)	70	3.3×10^{-2}	15000		D-1 Tension	Type I-A is the sample produced by special process and cut in axial direction
		3.33×10^{2}	18500			
		5×10^{2}	20500			
		5.17×10^{2}	22500			
		5.67×10^{2}	24000			
		6.33×10^{2}	28000			
		6.5×10^{2}	24500			
		7×10^{2}	28000			
		7.2×10^{2}	26000			
		7.33×10^{2}	27000			
PE(Type I-P)	70	3.33×10^{-2}	4800		D-1 Tension	Type I-P is the sample produced by special process and cut in perpendicular direction
		3.58×10^{2}	7200			
		5.17×10^{2}	8800			
		5.33×10^{2}	11600			
		6.17×10^{2}	10400			
		6.5×10^{2}	11000			

Material	T(°F)	$\dot{\varepsilon}$(/sec)	σ_Y(psi)	Elong. (%)	Ref.	Remarks
PE(Type II-A)	70	4.17×10^{2}	6200		D-1 Tension	Type II-A is the sample produced by conventional proc. and cut in axial direction
		6.9×10^{2}	6200			
		8.17×10^{2}	8800			
PE(Type II-P)	70	2.83×10^{2}	5000		D-1 Tension	Type II-P is the sample produced by conv. process and cut perpendicular direction
		5×10^{2}	5700			
		6.38×10^{2}	9000			
PE	-58	3.3×10^{-4}	5620		E-1 Tension	Read from (σ_Y, $\dot{\varepsilon}$) curves All specimens were dried 48 hrs. at 122F & stored in a desiccator until used (max.strength) (Bakelite DYNH 1-3) Strain rate=cross-head velocity/gage length
		1.67×10^{-2}	6000			
		8.3×10^{-2}	6000			
	-40	3.3×10^{-4}	5100			
		3.3×10^{-3}	5600			
		1.67×10^{-2}	5000			
		8.3×10^{-2}	5600			
		3.3×10^{-1}	6330			
		4.33×10^{0}	7000			
		2.67×10^{1}	7320			
	-4	3.3×10^{-4}	3800			
		1.67×10^{-2}	4000			
		4.33×10^{0}	4770			
		2.667×10^{1}	5200			
	32	3.3×10^{-4}	3050			
		1.67×10^{-2}	3200			
		8.3×10^{-2}	3300			
		4.33×10^{0}	3700			
		2.667×10^{1}	4170			
	76	3.3×10^{-4}	2200	68		

Material	T(°F)	$\dot{\epsilon}$(/sec)	σ_Y(psi)	Elong. (%)	Ref.	Remarks
		3.3×10^{-3}	2160	73		
		1.67×10^{-2}	2160	73		
		8.3×10^{-2}	2300	70		
		3.3×10^{-1}	2400	72		
		4.33×10^{0}	2600	68		
		2.667×10^{1}	2800	66		
PE	122	3.3×10^{-4}	1500			
		3.33×10^{-3}	1550			
		1.67×10^{-2}	1600			
		8.33×10^{-2}	1700			
		3.33×10^{-1}	1840			
		4.33×10^{0}	2000			
		2.67×10	2150			
	158	3.3×10^{-4}	1210			
		1.67×10^{-2}	1210			
		4.3×10^{0}	1230			
		2.67×10^{1}	1500			
PE	-65	8.5×10^{-3}	5140		J-1 Tension	(Dupont Surlyn A) 46% R.H. Read from (σ, ϵ) curves Max stress $= \sigma_Y$
	-40	8.5×10^{-3}	4610			
	-20	8.5×10^{-3}	3490			
	0	8.5×10^{-3}	2950			
	70	8.5×10^{-3}	2440			
		1.85×10^{-2}	2670			
		4.58×10^{-2}	2950			
PE(high density)	room	1.67×10^{-4}	2750		K-2 Tension	Sample according to ASTM D638 .935g/cm^3 H.T. 302 °F, 15 min. 1 atm. Read from tables
		1.67×10^{-3}	3500			
		1.67×10^{-2}	4230			

Material	T(°F)	$\dot{\varepsilon}$(/sec)	σ_Y(psi)	Elong. (%)	Ref.	Remarks
		1.67×10^{-3}	>3800	800		H.T. 306°F, 15 min, 1500 psi
		1.67×10^{-3}	>1000			H.T. 306°F, 15 min, 1 atm, .957 g/cm³
PE(low density)	room	1.67×10^{-3}	1520	475	K-2 Tension	
		1.67×10^{-3}	1675	418		H.T. 271°F, 5 min, 1atm
PE(linear)	73.4	3.3×10^{-3}	3200	200	S-1 Tension	Marlex 50-Type 40 strain rate is app. by deformation speed divided by gauge length. sample cooled from moulding temp.
		3.3×10^{-2}	3560	200		
		3.3×10^{-1}	3820	17.3		
		3.3×10^{0}	4180	14.3		Read from table
		3.3×10^{1}	4500	14.0		
PE(low density)		3.3×10^{-3}	1075	200		Monsanto 406, cooled from moulding temp.
		3.3×10^{-2}	1250	200		
		3.3×10^{-1}	1360	200		
		3.3×10^{0}	1630	200		
		3.3×10^{1}	1640	200		
PE(high density)		3.3×10^{-3}	3150			
		1.67×10^{0}	4275	20		
		3.3×10^{1}	4500	27		
PE Terephthalate (Mylar)	-34.6	1.3×10^{-4}	19600		L-2 Tension	Read from curves (master curve) The molds were held at 140°F for 24 hrs. & at 230°F for 48 hrs.
		5.3×10^{-4}	20000			
		5.3×10^{-3}	21400			
		5.3×10^{-2}	22500			
	-3.2	3.5×10^{-4}	17260			
		9.8×10^{-4}	18000			
		9.8×10^{-3}	19000			
		9.8×10^{-2}	19400			

Material	T(°F)	$\dot{\epsilon}$(/sec)	σ_Y(psi)	Elong. (%)	Ref.	Remarks
	32.	7.5×10^{-5}	15400			
		2.9×10^{-4}	15540			
		2.9×10^{-3}	16000			
		2.9×10^{-2}	18000			
	77	1.3×10^{-3}	13000			
		8.3×10^{-3}	13750			
		5×10^{-3}	14150			
		3.3×10^{-2}	15200			
		8.33×10^{-2}	15080			
		4.2×10^{-1}	16400			
		1.67×10^{0}	17600			
		5×10^{0}	18400			
	122	7.1×10^{-5}	10650			
		3.3×10^{-4}	10500			
		3.3×10^{-3}	11500			
		3.3×10^{-2}	13000			
	167	6.7×10^{-5}	7700			
		5×10^{-4}	7650			
		5×10^{-3}	8500			
		4.2×10^{-2}	10000			
	194	3.3×10^{-5}	5150			
		2.8×10^{-4}	5400			
		2.8×10^{-3}	6800			
		2.8×10^{-2}	8030			
	212	1.67×10^{-4}	4060			
		5×10^{-3}	5000			
		4.41×10^{-2}	5800			

Material	T(°F)	$\dot{\epsilon}$(/sec)	σ_Y(psi)	Elong. (%)	Ref.	Remarks
	230	7.1×10^{-5}	3300			
		5.4×10^{-4}	4000			
		5×10^{-3}	4400			
		5×10^{-2}	5250			
	248	6×10^{-5}	3200			
		4.3×10^{-4}	3200			
		4.3×10^{-3}	4950			
		4.3×10^{-2}	4150			
	266	4.2×10^{-5}	2750			
		3.3×10^{-4}	3000			
		3.3×10^{-3}	3250			
		3.3×10^{-2}	3600			
PE Film	room	4.3×10^{0}	1780	513	P-1 Tension	Ave. value
		8.7×10^{0}	1500	639		
		3.4×10^{1}	1930	504		
		8.6×10^{1}	1900	509		
PE(high density)	room	2.7×10^{-3}	4220	32	W-1 Tension	Read from (σ_Y, ϵ) curves
		6.7×10^{-3}	4890	28		
		2.7×10^{-2}	5020	23.5		
		1.7×10^{-1}	5940	19.5		
		1.64×10^{0}	6890	15		
		1.68×10^{1}	8330	12.5		
		1×10^{2}	8710	12		
PE(low density)	room	2.7×10^{-3}	3310	50		
		6.7×10^{-3}	3620	49		
		2.7×10^{-2}	4050	47.8		

Material	T(°F)	$\dot{\varepsilon}$(/sec)	σ_Y(psi)	Elong. (%)	Ref.	Remarks
		1.7×10^{-1}	4650	46.8		
		1.64×10^{0}	5490	45		
		1.68×10^{1}	6280	43.3		
		1×10^{2}	7010	42		

TABLE 5 DYNAMIC PROPERTIES OF POLYETHYL METHACRYLATE (PEMA)

Material	T(°F)	$\dot{\epsilon}$(/sec)	σ_Y(psi)	Elong. (%)	Ref.	Remarks
PEMA	95	7.5×10^{-6}	3400		R-2 Tension	Read from (σ_Y, $\dot{\epsilon}$) curves Max stress = σ_Y
		3.86×10^{-5}	4120			
		1.87×10^{-4}	4610			
	104	7.5×10^{-6}	2360			
		3.86×10^{-5}	2820			
		1.87×10^{-4}	3290			
		7.66×10^{-4}	4220			
	122	7.5×10^{-6}	1460			
		3.86×10^{-5}	1570			
		1.87×10^{-4}	2010			
		9.15×10^{-4}	2720			
		3.06×10^{-3}	3370			
		1.19×10^{-2}	3900			
		2.04×10^{-2}	4210			
		2.95×10^{-2}	4800			
		5.38×10^{-2}	4690			
	140	7.5×10^{-6}	560			
		3.86×10^{-5}	800			
		1.87×10^{-4}	1130			
		9.15×10^{-4}	1700			
		3.46×10^{-3}	2220			
		1.19×10^{-2}	2790			
		1.75×10^{-2}	3000			
		3.53×10^{-2}	3500			
		5.83×10^{-2}	3850			
		1.44×10^{-1}	4440			
		2.95×10^{-1}	5060			
	158	9.15×10^{-4}	570			
		3.46×10^{-3}	1210			
		5.12×10^{-3}	1210			
		8.71×10^{-3}	1200			
		1.75×10^{-2}	1580			

Material	T(°F)	$\dot{\epsilon}$(/sec)	σ_Y(psi)	Elong. (%)	Ref.	Remarks
		5.38×10^{-2}	1940			
		1.7×10^{-1}	2800			
		2.42×10^{-1}	3480			
		3.98×10^{-1}	3520			
		6.31×10^{-1}	3880			
		1×10^{0}	4340			
		1.305×10^{0}	4700			
		2.03×10^{0}	5000			
		2.51×10^{0}	5170			
	176	5.1×10^{-3}	260			
		1.75×10^{-2}	510			
		2.04×10^{-2}	570			
		5.38×10^{-2}	980			
		1.44×10^{-1}	1510			
		2.95×10^{-1}	1970			
		6.31×10^{-1}	2240			
		1×10^{0}	2560			
		1.305×10^{0}	2680			
		2.03×10^{0}	2860			
		1×10^{1}	4470			
		1.2×10^{1}	5130			

TABLE 6 DYNAMIC PROPERTIES OF POLYMETHYL METHACRYLATE (PMMA)

Material	T(°F)	$\dot{\epsilon}$(/sec)	σ_Y(psi)	Elong. (%)	Ref.	Remarks
PMMA	-58	2.5×10^{-4}	36400		B-5 Comp.	Read from (σ_Y, $\dot{\epsilon}$) curves Annealed for a day at 230°F then cooled to room temp. slowly (Commercial I.C.I. Perspex)
		5×10^{-4}	39400			
		1×10^{-3}	39400			
		1.1×10^{-3}	39800			
		2.2×10^{-3}	40100			
		3.2×10^{-3}	41600			
		4.2×10^{-3}	42000			
		8.3×10^{-3}	45400			
		1.35×10^{-2}	45450			
	71.6	2.5×10^{-4}	17100			
		5×10^{-4}	17980			
		1.1×10^{-3}	19300			
		2.2×10^{-3}	20200			
		4.2×10^{-3}	21000			
		8.3×10^{-3}	22100			
	158	2.5×10^{-4}	8520			
		5×10^{-4}	8000			
		1.1×10^{-3}	10000			
		2.2×10^{-3}	10500			
		4.2×10^{-3}	11360			
		8.3×10^{-3}	11700			
		1.6×10^{-2}	12400			
PMMA	72	2×10^{-4}	8750		C-2 Comp.	Read from (σ , ϵ) curves Max stress = σ_Y
		2×10^{-3}	10000			
		2×10^{-2}	10900			
		2×10^{-1}	14000			
		3×10^{0}	16500			
		4.5×10^{1}	20500			
		7.6×10^{2}	30300			
PMMA	104	4.2×10^{-4}	5460		D-2 Tension	Read from (σ , ϵ) curves Data of Ref. 7 in D-2; strain rate= speed/gage length (Plexiglas)
		8.3×10^{-4}	6000			
		1.7×10^{-3}	6400	6.8		
		3.3×10^{-3}	7100	6.5		

Material	T(°F)	$\dot{\varepsilon}$(/sec)	σ_Y(psi)	Elong. (%)	Ref.	Remarks
Commercial Methyl Methacrylate	room	$5.1x10^{-3}$	11500		D-2 Comp.	Read from (σ , ε) curves Compression Max stress = σ_Y
		$2.5x10^{-2}$	12600			
		$1.2x10^{-1}$	14400			
		$9.6x10^{-1}$	17100			
		$3.15x10^{0}$	18800			
		$4.2x10^{-4}$	6500			Tension(ASTM D638-46T)
		$5.7x10^{-3}$	10000			
PMMA	76	$5x10^{-5}$	7900		E-1 Tension	Read from (σ_Y , $\dot{\varepsilon}$) curves All specimens were dried 48 hrs. at 122°F & stored in a desiccator until used (Plexiglas IA-UVA)
		$1.3x10^{-4}$	8250			
		$3x10^{-4}$	8300			
		$4.5x10^{-4}$	9200			
		$3x10^{-3}$	10500			
		$1.33x10^{-2}$	11500			
		$6.83x10^{-2}$	13000			
		$3x10^{-1}$	14000			
		$1x10^{0}$	14500			
		$1.83x10^{1}$	16500			
PMMA	32	$5x10^{-5}$	21900		H-3 Comp.	Read from (σ_Y , $\dot{\varepsilon}$) curves (Commerc. Plexiglass II) Max stress = σ_Y
		$5x10^{-4}$	25800			
		$5x10^{-2}$	34000			
	71.6	$5x10^{-5}$	17500			
		$5x10^{-4}$	20630			
		$5x10^{-2}$	25100			
		$5x10^{-1}$	31300			
		$8x10^{0}$	35000			
	122	$5x10^{-5}$	13130			
		$5x10^{-4}$	15000			
		$5x10^{-2}$	16500			
		$8x10^{0}$	30000			
		$7.6x10^{3}$	36000			
	179	$5x10^{-5}$	7500			
		$5x10^{-4}$	8800			
		$5x10^{-2}$	13130			
		$8x10^{0}$	17900			

Material	T(°F)	$\dot{\epsilon}$(/sec)	σ_Y(psi)	Elong. (%)	Ref.	Remarks
	239	$5x10^{-5}$	3000			
		$5x10^{-4}$	5000			
		$5x10^{-2}$	6300			
		$1.5x10^{3}$	8630			
PMMA	-58	$1.7x10^{-5}$	12900		K-1 Tension	Read from table True strain rate True stress
		$1.7x10^{-4}$	14900			
		$1.7x10^{-3}$	16000			
		$1.7x10^{-2}$	18500			
	-13	$1.7x10^{-5}$	13000			
		$1.7x10^{-4}$	15400			
		$1.7x10^{-3}$	16800			
		$1.7x10^{-2}$	16600			
	32	$1.7x10^{-5}$	12000			
		$1.7x10^{-4}$	11800			
		$1.7x10^{-3}$	15000			
		$1.7x10^{-2}$	16100			
	77	$1.7x10^{-5}$	7200			
		$1.7x10^{-4}$	9200			
		$1.7x10^{-3}$	11100			
		$1.7x10^{-2}$	14000			
	122	$1.7x10^{-5}$	5400			
		$1.7x10^{-4}$	6000			
		$1.7x10^{-3}$	7300			
		$1.7x10^{-2}$	9360			
	167	$1.7x10^{-5}$	2630			
		$1.7x10^{-4}$	3400			
		$1.7x10^{-3}$	4340			
		$1.7x10^{-2}$	5850			
PMMA-G	-68	$3x10^{-4}$	18000		L-2 Tension	Read from (master curve) curves (Plexiglass G) ASTM D-638
		$8.3x10^{-4}$	19000			
		$8.3x10^{-3}$	19100			
	-4	$9.2x10^{-5}$	15850			
		$7x10^{-4}$	16750			
		$7.5x10^{-3}$	18350			
	50	$1.7x10^{-4}$	10380			
		$4.2x10^{-4}$	12700			
		$4.2x10^{-3}$	13200			

Material	T(°F)	$\dot{\epsilon}$(/sec)	σ_Y(psi)	Elong. (%)	Ref.	Remarks
		4.2×10^{-2}	16100			
	77	1.3×10^{-3}	11200			
		5×10^{-3}	12500			
		3.3×10^{-2}	13600			
		5.8×10^{-2}	13600			
		8.3×10^{-2}	14400			
		4.2×10^{-1}	15300			
		1.67×10^{0}	16300			
		5×10^{0}	17000			
	104	1.7×10^{-4}	8000			
		1.3×10^{-3}	9000			
		1.3×10^{-2}	10400			
		1.3×10^{-1}	11700			
	149	1.2×10^{-4}	5460			
		2.5×10^{-4}	6340			
		2.5×10^{-3}	7050			
		2.5×10^{-2}	8400			
	176	3.8×10^{-4}	4250			
		3.8×10^{-3}	5100			
		3.8×10^{-2}	6100			
	194	5×10^{-4}	3150			
		5×10^{-3}	4200			
		5×10^{-2}	5250			
	203	1×10^{-4}	1800			
		6×10^{-3}	3000			
		6×10^{-2}	4450			
	212	9×10^{-5}	1000			
		6×10^{-4}	1550			
		6×10^{-3}	2850			
		6×10^{-2}	4100			
	221	1.7×10^{-4}	350			
		1×10^{-2}	1680			
		1×10^{-1}	2350			
	230	6.3×10^{-3}	500			
		6.3×10^{-2}	1500			
	239	6.7×10^{-4}	1000			

Material	T(°F)	$\dot{\varepsilon}$(/sec)	σ_Y(psi)	Elong. (%)	Ref.	Remarks
		4.17×10^{0}	2500			
PMMA	-58	4.8×10^{-5}	15000		L-3 Tension	ASTM-D-638 Specimen Read from (σ_Y, $\dot{\varepsilon}$) curves (Plexiglass UVA II)
		4.8×10^{-4}	17300			
		4.8×10^{-3}	18700			
		4.8×10^{-2}	19300			
	-13	4.8×10^{-5}	13300			
		4.8×10^{-4}	15100			
		4.8×10^{-3}	15400			
		4.8×10^{-2}	18100			
	32	4.8×10^{-5}	10700			
		4.8×10^{-4}	12300			
		4.8×10^{-3}	14700			
		4.8×10^{-2}	16000			
	71.6	4.8×10^{-5}	9100			
		4.8×10^{-4}	10700			
		4.8×10^{-3}	12100			
		4.8×10^{-2}	14100			
	122	4.8×10^{-5}	4900			
		4.8×10^{-4}	6400			
		4.8×10^{-3}	7300			
		4.8×10^{-2}	9000			
	158	4.8×10^{-4}	4000			
		4.8×10^{-3}	5100			
		4.8×10^{-2}	6300			
	194	4.8×10^{-5}	2100			
		4.8×10^{-4}	3100			
		4.8×10^{-3}	4000			
		4.8×10^{-2}	5300			
PMMA	75	3.3×10^{-3}	10800	6	M-1 Tension	Strain Rate= elongation rate/gauge length Read from (σ , ε) curves (Rohm & Haas Plexiglas)
	98	3.3×10^{-3}	9900	7.5		
	100	3.3×10^{-3}	9400	12.4		
	129	3.3×10^{-3}	7100			
	186	3.3×10^{-3}	4000			

Material	T(°F)	$\dot{\varepsilon}$(/sec)	σ_Y(psi)	Elong. (%)	Ref.	Remarks
PMMA	32	1.7×10^{-5}	10650		M-2 Tension	Read from (σ_Y, $\dot{\varepsilon}$) curves
		1.7×10^{-4}	11750			
		1.7×10^{-2}	14050			
	76	1.7×10^{-5}	6500			
		1.7×10^{-4}	8500			
		1.7×10^{-3}	10050			
		1.7×10^{-2}	12000			
	122	1.7×10^{-5}	3940			
		1.7×10^{-4}	4700			
		1.7×10^{-3}	5900			
		1.7×10^{-2}	8250			
PMMA	86	8.4×10^{-6}	7600		R-1 Tension	Read from (σ_Y, $\dot{\varepsilon}$) curves Max stress = σ_Y
		4.1×10^{-5}	8050			
		1.7×10^{-4}	9030			
	104	8.4×10^{-6}	6500			
		4.1×10^{-5}	7200			
		1.7×10^{-4}	7870			
	122	8.4×10^{-6}	5700			
		4.1×10^{-5}	6220			
		1.7×10^{-4}	6870			
		2.4×10^{-3}	7890			
		7.4×10^{-3}	9050			
		1×10^{-2}	9050			
		4.9×10^{-2}	10500			
		1×10^{-1}	10900			
		2.4×10^{-1}	12200			
	140	8.4×10^{-6}	4450			
		4.1×10^{-5}	5260			
		1.7×10^{-4}	5650			
		2.9×10^{-3}	7080			
		7×10^{-3}	7500			
		1.7×10^{-2}	7660			
		3.5×10^{-2}	8140			
		1×10^{-1}	9240			
		2.4×10^{-1}	10400			
		1.3×10^{0}	11900			

Material	T(°F)	$\dot{\epsilon}$(/sec)	σ_Y(psi)	Elong. (%)	Ref.	Remarks
	158	8.4×10^{-6}	3300			
		4.1×10^{-5}	3900			
		1.7×10^{-4}	4400			
		3.5×10^{-3}	5470			
		1×10^{-2}	6200			
		4.9×10^{-2}	7150			
		1×10^{-1}	7900			
		6.4×10^{-1}	9470			
		1.02×10^{0}	9900			
		2.9×10^{0}	11300			
	176	8.4×10^{-6}	2540			
		4.1×10^{-5}	2940			
		1.7×10^{-4}	3550			
		2.4×10^{-3}	4200			
		4.1×10^{-3}	4570			
		1×10^{-2}	5330			
		1.7×10^{-2}	5580			
		4.9×10^{-2}	6140			
		1×10^{-1}	6500			
		1.9×10^{-1}	7260			
		2.4×10^{-1}	7700			
		6.4×10^{-1}	8370			
		1.017×10^{0}	8830			
		1.3×10^{0}	8880			
		2.4×10^{0}	9640			
	194	8.4×10^{-6}	1566			
		4.1×10^{-5}	2090			
		1.7×10^{-4}	2700			
		4.6×10^{-3}	3700			
		6×10^{-3}	3800			
		8.4×10^{-3}	3860			
		1.5×10^{-2}	4300			
		3.5×10^{-2}	4440			
		7.5×10^{-2}	4700			
		1×10^{-1}	5530			
		3.8×10^{-1}	5850			

Material	T(°F)	$\dot{\varepsilon}$(/sec)	σ_Y(psi)	Elong. (%)	Ref.	Remarks
		5.8×10^0	6160			
		8×10^0	6730			
		9.2×10^1	7200			
		1.2×10^0	7830			
		3.84×10^0	8460			
		8.5×10^0	9450			
Lucite	room	0.	15060		T-1	Read from (σ ,
		1.5×10^2	21250		Comp.	ε) curves (Methyl Methacry-
		2.9×10^2	26250			late)
		4.8×10^2	30500	5		$\dot{\varepsilon}$ = mean strain
		5.9×10^2	40000	4		rate

TABLE 7 DYNAMIC PROPERTIES OF POLYPROPYLENE (PP)

Material	T(°F)	$\dot{\varepsilon}$(/sec)	σ_Y(psi)	Elong. (%)	Ref.	Remarks
PP	-148	5.3×10^{-1}	8460		B-1	Atactic PP
		3.4×10^{0}	8200		Torsion	Read from (σ_Y, $\dot{\varepsilon}$) curves
		2.4×10^{1}	7030			Effective strain rate
		1.1×10^{2}	5740			
		8.88×10^{2}	6780			
	-112	5.3×10^{-1}	8200			
		3.4×10^{0}	7800			
		2.4×10^{1}	6900			
		1.1×10^{2}	5820			
		8.88×10^{2}	7000			
	-76	5.3×10^{-1}	7850			
		3.36×10^{0}	7280			
		2.4×10^{1}	6700			
		1.1×10^{2}	6400			
		8.88×10^{2}	5900			
	-40	5.3×10^{-1}	6730			
		3.36×10^{0}	6520			
		2.4×10^{1}	6000			
		1.10×10^{2}	5460			
		8.88×10^{2}	5690			
	-4	5.3×10^{-1}	5150			
		3.4×10^{0}	5750			
		2.4×10^{1}	5320			
		1.10×10^{2}	4600			
		8.88×10^{2}	4540			
PP	72	2×10^{-4}	4830		C-2	Read from (σ , ε) curves
		2×10^{-3}	6350		Comp.	
		2×10^{-2}	6830			Max stress = σ_Y
		2×10^{-1}	7350			
		4×10^{0}	8500			
		5×10^{1}	10000			
		1.5×10^{3}	16500			

Material	T(°F)	$\dot{\varepsilon}$(/sec)	σ_Y(psi)	Elong. (%)	Ref.	Remarks
PP	20	6.5×10^{-4}	7300	32.3	H-1 Tension	Read from (σ_Y, $\dot{\varepsilon}$) curves (Isotactic PP)
	32	6.5×10^{-4}	6950	36		
	52	6.5×10^{-4}	5920	52.5		
	68	3.3×10^{-4}	5000	58.7		
		6.5×10^{-4}	5250	57		
		2×10^{-3}	6300	61		
		4.5×10^{-3}	6780	59.5		
		4×10^{-2}	7090	37.7		
		2.5×10^{-1}	7590	24		
		3×10^{0}	8100	21		
		3.5×10^{1}	7900	19		
		7×10^{1}	8400	18.8		
		1.4×10^{2}	9090	20		
		3×10^{2}	10200	19		
		4.9×10^{2}	10440	17.8		
	96	6.5×10^{-4}	3780	74.6		
IPP	50	2×10^{-4}	5480		R-3 Tension	Read from curves (σ_Y, $\dot{\varepsilon}$) (Isotactic PP) Max stress $=\sigma_Y$
		8×10^{-4}	5950			
		1.2×10^{-2}	6750			
		2.3×10^{-2}	6500			
		1.5×10^{-1}	7300			
		2.8×10^{-1}	7450			
		6×10^{-1}	7870			
		1.64×10^{0}	7850			
		6.45×10^{0}	8560			
	86	7×10^{-6}	3000			
		3.7×10^{-5}	3480			
		2×10^{-4}	3890			
		8.7×10^{-4}	4280			
		6.4×10^{-3}	4760			
		1×10^{-2}	4760			
		1.8×10^{-2}	5240			
		3.2×10^{-2}	5240			
		4.7×10^{-2}	5360			
		3.5×10^{-1}	6100			

Material	T(°F)	$\dot{\epsilon}$(/sec)	σ_Y(psi)	Elong. (%)	Ref.	Remarks
		$1x10^{0}$	6380			
		$4.4x10^{0}$	7000			
		$6.5x10^{0}$	7020			
		$1x10^{1}$	7020			
	122	$7x10^{-6}$	2340			
		$3.7x10^{-5}$	2590			
		$2x10^{-4}$	2760			
		$8.7x10^{-4}$	3060			
		$4x10^{-3}$	3250			
		$1x10^{-2}$	3260			
		$1.8x10^{-2}$	3800			
		$1x10^{-1}$	3850			
		$3.5x10^{-1}$	4500			
		$1x10^{0}$	4950			
		$1.6x10^{0}$	4950			
		$6.5x10^{0}$	5430			
		$1x10^{1}$	5450			
	158	$7x10^{-6}$	1890			
		$3.7x10^{-5}$	2030			
		$2x10^{-4}$	2200			
		$8.7x10^{-4}$	2360			
		$8.4x10^{-3}$	2490			
		$2x10^{-2}$	2400			
		$3.3x10^{-2}$	2500			
		$9.1x10^{-2}$	2530			
		$3.5x10^{-1}$	3250			
		$6x10^{-1}$	3450			
		$1x10^{0}$	3600			
		$2.8x10^{0}$	3750			
		$6.5x10^{0}$	4450			
		$1x10^{1}$	4340			
	194	$7x10^{-6}$	1320			
		$3.7x10^{-5}$	1420			
		$2x10^{-4}$	1500			

Material	T(°F)	$\dot{\varepsilon}$(/sec)	σ_Y(psi)	Elong. (%)	Ref.	Remarks
		8.7×10^{-4}	1610			
		4×10^{-3}	1800			
		1.8×10^{-2}	1830			
		4.5×10^{-2}	2020			
		9.1×10^{-2}	2120			
		3.5×10^{-1}	2310			
		6×10^{-1}	2540			
		1×10^{0}	2800			
		1.64×10^{0}	2720			
		2.7×10^{0}	3040			
		6.5×10^{0}	3040			
		1×10^{1}	3340			
	230	2×10^{-4}	1070			
		8.7×10^{-4}	1280			
		2.3×10^{-2}	1390			
		3.8×10^{-2}	1390			
		4.7×10^{-1}	1520			
		1×10^{0}	1800			
		6.5×10^{0}	2300			
Crystalline PP	73.4	3.3×10^{-3}	4340	200	S-1	Annealed at 275°F
		3.3×10^{-2}	4640	200	Tension	for 3 hrs. in a vacuum oven (Profax)
		3.3×10^{-1}	4570	14.7		Strain rate=speed/ gage length
		3.3×10^{0}	5120	12.9		
		3.3×10^{1}	5590	15.8		

TABLE 8 DYNAMIC PROPERTIES OF POLYSTYRENE (PS)

Material	T(°F)	$\dot{\varepsilon}$(/sec)	σ_Y(psi)	Elong. (%)	Ref.	Remarks
PS	74.3	1.7×10^{-2}	11240	6	A-1	50% R.H.
		8.3×10^{-2}	9200	5	Tension	(oriented)
		1.7×10^{-1}	4900	6		
PS	-350	3×10^{-3}	28400		A-2	Read from (σ , ε) curves
	-197	3×10^{-3}	24000		Comp.	(Atactic PS)
	-108	3×10^{-3}	20000			Max stress = σ_Y
	32	2×10^{-4}	12800			
		3×10^{-3}	13000			
		1.2×10^{-2}	14900			
	71.6	2×10^{-4}	10200			
		2×10^{-3}	11200			
		1.2×10^{-2}	12800			
PS	68	3.6×10^{-4}	13560		B-5	Read from (σ_Y, ε) curves $\varepsilon(\sigma,\varepsilon)$
	70	1.9×10^{-4}	11800		Comp.	Annealed for a day
		3.5×10^{-4}	12800			at 212°F, then cooled
		3.6×10^{-4}	11600			slowly to room temp.
		7×10^{-4}	12500			(Amorphous polystyrene)
		1.5×10^{-3}	12400			
		2×10^{-3}	13700			
		3×10^{-3}	13200			
		5.5×10^{-3}	14200			
		6×10^{-3}	13700			
		1.25×10^{-2}	14300			
		2.5×10^{-2}	14500			
	86	3.6×10^{-4}	12500			
	104	3.6×10^{-4}	11500			
	122	3.6×10^{-4}	10500			
	131	3.6×10^{-4}	9830			
	140	3.6×10^{-4}	8700			
	149	3.6×10^{-4}	7380			
	158	2×10^{-4}	6300			
		3.6×10^{-4}	6450			
		4×10^{-4}	7100			
		7×10^{-4}	7400			
		1.5×10^{-3}	8380			

Material	T(°F)	$\dot{\varepsilon}$(/sec)	σ_Y(psi)	Elong. (%)	Ref.	Remarks
		3×10^{-3}	9500			
		6×10^{-3}	9200			
		1.25×10^{-2}	9750			
		2.5×10^{-2}	10000			
		5×10^{-2}	11000			
	167	1.9×10^{-4}	5100			
		3.6×10^{-4}	5500			
		1.5×10^{-3}	7580			
	176	1.9×10^{-4}	1610			
		2×10^{-4}	1770			
		3.6×10^{-4}	2340			
		5×10^{-4}	2220			
		7.3×10^{-4}	2900			
		9×10^{-4}	2980			
		5×10^{-3}	3710			
		2×10^{-3}	3630			
		3.5×10^{-3}	4680			
PS	104	6.7×10^{-5}	8800		B-6 Comp.	Read from (σ_Y, $\dot{\varepsilon}$) curves APS ideal quenched from 221°F through Tg (Atactic polystyrene) σ_Y= peak load/true area at notch $\dot{\varepsilon}$ = crosshead speed/ length at the peak load
		6.7×10^{-4}	10500			
		6.7×10^{-3}	12000			
		6.7×10^{-2}	14500			
	140	6.7×10^{-5}	5800			
		6.7×10^{-4}	7200			
		6.7×10^{-3}	9500			
		6.7×10^{-2}	11500			
	176	6.7×10^{-5}	1670			
		6.7×10^{-4}	2330			
		6.7×10^{-3}	4200			
		6.7×10^{-2}	6670			
PS	104	6.7×10^{-5}	13200			Quenched from 221°F and reannealed 6 days at 167°F (Atactic Polystyrene)
		6.7×10^{-4}	13500			
		6.7×10^{-3}	14000			
		6.7×10^{-2}	14500			
	140	6.7×10^{-5}	9300			
		6.7×10^{-4}	11000			
		6.7×10^{-3}	12400			

Material	T(°F)	$\dot{\epsilon}$(/sec)	σ_Y(psi)	Elong. (%)	Ref.	Remarks
		6.7×10^{-2}	13200			
	176	6.7×10^{-5}	4400			
		6.7×10^{-4}	6200			
		6.7×10^{-3}	8300			
		6.7×10^{-2}	10000			
PS	73.4	1.7×10^{-5}	5330		C-1 Tension	Read from (σ , ϵ) curves Annealed
		1.7×10^{-4}	5500			
		1.7×10^{-3}	6250			Fracture stress = σ_Y
		1.7×10^{-2}	6600			
PS	room	1.7×10^{-4}	5700		D-2 Tension	Read from (σ_Y, $\dot{\epsilon}$) curves Ref. 16 & 17 in Ref. D-2
		1.7×10^{-3}	6500			
		1.7×10^{-2}	7400			
PS	room	3.3×10^{-5}	7400			
		4×10^{-4}	8540			
		7.5×10^{-3}	10100			
Heat-resistant PS	room	4×10^{-5}	8100			
		4×10^{-4}	9060			
		6×10^{-3}	11200			
PS	-168	1×10^{-5}	21800		H-2 Comp.	Read from (σ_Y, $\dot{\epsilon}$) curves (GP PS)
		1×10^{-4}	22200			
		1×10^{-3}	22600			
	77	1×10^{-5}	10000			
		1×10^{-4}	10600			
		1×10^{-3}	11500			
	149	1×10^{-5}	3550			
		1×10^{-4}	4820			
		1×10^{-3}	6080			
PS	77	1.2×10^{-5}	10400		H-4 Comp.	Read from (σ , ϵ) curves
		4.8×10^{-5}	11200			Max stress = σ_Y
		2×10^{-4}	12400			
		7×10^{-4}	13200			
PS	-40	4.2×10^{-3}	5870	15.2	I-1 Tension	Read from (σ_Y, T) curves (High-impact polystyrene) (Styron 475S)
		4.2×10^{-2}	6430	13.8		
		4.2×10^{-1}	6900	11.3		

Material	T(°F)	$\dot{\varepsilon}$(/sec)	σ_Y(psi)	Elong. (%)	Ref.	Remarks
	-4	4.2×10^{-3}	4880	15.9		
		4.2×10^{-2}	5550	14.1		
		4.2×10^{-1}	5900	12.5		
	0	4.2×10^{-3}	4050	38.6		
		4.2×10^{-2}	4720	29.5		
		4.2×10^{-1}	5470	16.8		
	68	4.2×10^{-3}	3480	54.8		
		4.2×10^{-2}	4150	38.6		
		4.2×10^{-1}	4580	27.7		
	104	4.2×10^{-3}	3160	62.3		
		4.2×10^{-2}	3480	45.5		
PS	-34.6	4.3×10^{-3}	7780		L-2	Read from master
		4.3×10^{-2}	7110		Tension	curve Molds were held at
	-3.2	3.3×10^{-3}	7110			140°F for 24 hrs.
		1×10^{-2}	7330			& at 230°F for 48 hrs.
		1×10^{-1}	7780			
	51.8	1.6×10^{-3}	5780			
		1×10^{-2}	5780			
		1×10^{-1}	6670			
	75.2	1.1×10^{-4}	5000			
		6.7×10^{-4}	5600			
		3.3×10^{-2}	6400			
		6.7×10^{-2}	7000			
		9.2×10^{-2}	7200			
		5×10^{-1}	7600			
		1.67×10^{0}	6400			
		2.1×10^{0}	7800			
		5×10^{0}	8000			
	107.6	1×10^{-3}	4440			
		3.3×10^{-3}	4880			
		3.3×10^{-2}	5780			
	154.6	3.3×10^{-3}	3560			
		3.3×10^{-2}	4000			
	167	1×10^{-1}	2670			
	176	1×10^{-4}	890			
		1×10^{-3}	1780			

Material	T(°F)	$\dot{\varepsilon}$(/sec)	σ_Y(psi)	Elong. (%)	Ref.	Remarks
		$1x10^{-2}$	2890			
	185	$3.3x10^{-3}$	2670			
	197	$3.3x10^{-2}$	1330			
	203	$1.7x10^{-2}$	440			
Rubber-modified PS (Lustrex HT 88-1)	room	$4.8x10^{-1}$	3970	4.5	L-4 Tension	Read from (σ_Y, $\dot{\varepsilon}$) curve
		$4.8x10^{0}$	4710	5.1		
		$2.33x10^{1}$	5570	6.8		

TABLE 9 DYNAMIC PROPERTIES OF POLYVINYLCHLORIDE (PVC)

Material	T(°F)	$\dot{\varepsilon}$(/sec)	σ_Y(psi)	Elong. (%)	Ref.	Remarks
PVC	-58	4.2×10^{-5}	13240		B-2 Tension	Read from (σ_Y, $\dot{\varepsilon}$) curves (Solvic 227, Solvay et Cie) $\dot{\varepsilon}$ is calculated from crosshead speed
		4.2×10^{-4}	14820			
		4.2×10^{-3}	15850			
		4.2×10^{-2}	16870			
	-31	4.2×10^{-5}	11845			
		2.1×10^{-4}	12540			
		4.2×10^{-4}	12690			
		8.3×10^{-4}	13200			
		2.1×10^{-3}	13360			
		4.2×10^{-3}	13750			
		8.3×10^{-3}	14420			
		2.1×10^{-2}	14530			
		4.2×10^{-2}	15420			
		8.3×10^{-2}	15750			
	32	4.2×10^{-5}	8740			
		8.3×10^{-5}	8830			
		2.1×10^{-4}	9100			
		4.2×10^{-4}	9350			
		8.3×10^{-4}	9580			
		2.1×10^{-3}	9870			
		4.2×10^{-3}	10200			
		8.3×10^{-3}	10650			
		2.1×10^{-2}	10770			
		8.3×10^{-2}	11600			
		2.1×10^{-1}	11800			
	73.4	8.3×10^{-6}	6050			
		2.1×10^{-5}	6310			
		4.2×10^{-5}	6580			
		8.3×10^{-5}	6810			
		2.1×10^{-4}	7100			
		4.2×10^{-4}	7350			
		8.3×10^{-4}	7480			
		2.1×10^{-3}	7880			
		4.2×10^{-3}	8000			

Material	T(°F)	$\dot{\varepsilon}$(/sec)	σ_Y(psi)	Elong. (%)	Ref.	Remarks
		8.3×10^{-3}	8340			
		2.1×10^{-2}	8560			
		4.2×10^{-2}	8890			
		8.3×10^{-2}	9010			
		2.1×10^{-1}	9280			
	86	8.3×10^{-6}	5490			
		2.1×10^{-5}	5720			
		4.2×10^{-5}	6010			
		8.3×10^{-5}	6150			
		2.1×10^{-4}	6430			
		4.2×10^{-4}	6530			
		8.3×10^{-4}	6770			
		2.1×10^{-3}	7050			
		4.2×10^{-3}	7380			
		8.3×10^{-3}	7610			
		2.1×10^{-2}	7990			
		4.2×10^{-2}	8130			
		8.3×10^{-2}	8460			
		2.1×10^{-1}	8720			
	104	8.3×10^{-6}	4640			
		2.1×10^{-5}	4760			
		4.2×10^{-5}	5000			
		8.3×10^{-5}	5200			
		2.1×10^{-4}	5440			
		4.2×10^{-4}	5800			
		8.3×10^{-4}	5900			
		2.1×10^{-3}	6290			
		4.2×10^{-3}	6480			
		8.3×10^{-3}	6670			
		2.1×10^{-2}	7120			
		4.2×10^{-2}	7300			
		8.3×10^{-2}	7510			
		2.1×10^{-1}	7790			
	122	2.1×10^{-4}	4350			
		4.2×10^{-4}	4710			
		8.3×10^{-4}	4980			

Material	T(°F)	$\dot{\varepsilon}$(/sec)	σ_Y(psi)	Elong. (%)	Ref.	Remarks
		2.1×10^{-3}	5400			
		4.2×10^{-3}	5570			
		8.3×10^{-3}	5880			
		2.1×10^{-2}	6170			
		4.2×10^{-2}	6520			
		8.3×10^{-2}	6600			
		2.1×10^{-1}	6820			
	140	2.1×10^{-3}	3980			
		4.2×10^{-3}	4620			
		8.3×10^{-3}	4740			
		2.1×10^{-2}	5030			
		4.2×10^{-2}	5360			
		8.3×10^{-2}	5550			
		2.1×10^{-1}	5700			
	158	4.2×10^{-3}	3540			
		2.1×10^{-2}	4110			
		4.2×10^{-2}	4310			
		8.3×10^{-2}	4630			
		2.1×10^{-1}	4940			
PVC	122	2.1×10^{-5}	3460		B-3 Tension	Read from (σ_Y, $\dot{\varepsilon}$) curves (Solvic 227, Solvay et Cie) $\dot{\varepsilon}$ is calculated from crosshead speed
		4.2×10^{-5}	3840			
		8.3×10^{-5}	4010			
		2.1×10^{-4}	4390			
		4.2×10^{-4}	4690			
		8.3×10^{-4}	4910			
		2.1×10^{-3}	5280			
		4.2×10^{-3}	5530			
		8.3×10^{-3}	5720			
		2.1×10^{-2}	6120			
		4.2×10^{-2}	6410			
		8.3×10^{-2}	6630			
		2.1×10^{-1}	6870			
	140	2.1×10^{-5}	2410			
		4.2×10^{-5}	2600			
		8.3×10^{-5}	2810			
		2.1×10^{-4}	3130			

Material	T(°F)	$\dot{\epsilon}$(/sec)	σ_Y(psi)	Elong. (%)	Ref.	Remarks
		4.2×10^{-4}	3440			
		8.3×10^{-4}	3900			
		2.1×10^{-3}	4210			
		4.2×10^{-3}	4620			
		8.3×10^{-3}	4850			
		2.1×10^{-2}	4900			
		4.2×10^{-2}	5380			
		8.3×10^{-2}	5500			
		2.1×10^{-1}	5710			
	158	2.1×10^{-5}	1210			
		4.2×10^{-5}	1360			
		8.3×10^{-5}	1720			
		2.1×10^{-4}	1930			
		4.2×10^{-4}	2160			
		8.3×10^{-4}	2820			
		2.1×10^{-3}	3180			
		4.2×10^{-3}	3500			
		8.3×10^{-3}	3770			
		2.1×10^{-2}	4300			
		4.2×10^{-2}	4470			
		8.3×10^{-2}	4640			
		2.1×10^{-1}	4970			
	167	8.3×10^{-5}	350			
		2.1×10^{-4}	750			
		4.2×10^{-4}	1050			
		8.3×10^{-4}	1330			
		2.1×10^{-3}	1730			
		4.2×10^{-3}	2100			
		8.3×10^{-3}	2500			
		2.1×10^{-2}	2790			
		4.2×10^{-2}	3150			
		8.3×10^{-2}	3490			
		2.1×10^{-1}	3960			
	176	4.2×10^{-4}	500			
		8.3×10^{-3}	620			
		2.1×10^{-2}	880			

Material	T(°F)	$\dot{\varepsilon}$(/sec)	σ_Y(psi)	Elong. (%)	Ref.	Remarks
		4.2×10^{-2}	1260			
		8.3×10^{-2}	1480			
		2.1×10^{-1}	2140			
	185	8.3×10^{-2}	370			
		2.1×10^{-1}	810			
PVC	-40	4.2×10^{-3}	15100	37	I-1 Tension	Read from (σ_Y, T) curves (Geon 103 Ep)
		4.2×10^{-2}	16200	24		
	-4	4.2×10^{-3}	13450	53		
		4.2×10^{-2}	14900	27		
	32	4.2×10^{-3}	11160	63		
		4.2×10^{-2}	12470	47		
		4.2×10^{-1}	14900	22		
	68	4.2×10^{-3}	9160	90		
		4.2×10^{-2}	10300	61		
		4.2×10^{-1}	12200	26		
	104	4.2×10^{-3}	7020	230		
		4.2×10^{-2}	7800	117		
		4.2×10^{-1}	9200	43		
	140	4.2×10^{-3}	3640	270		
		4.2×10^{-2}	4830	240		
		4.2×10^{-1}	6320	43		
PVC	77	1.3×10^{-3}	9200		L-2 Tension	Read from master curve Molds were held at 140°F for 24 hrs. & at 230°F for 24 hrs.
		5×10^{-3}	10160			
		3.3×10^{-2}	11300			
		5.8×10^{-2}	10860			
		8.3×10^{-2}	11400			
		4.2×10^{-1}	12350			
		1.67×10^{0}	13640			
		5×10^{0}	14150			
	-34.6	3.3×10^{-4}	15500			
		1.3×10^{-3}	16270			
		1.3×10^{-2}	17700			
		1.3×10^{-1}	19800			
	3.2	1.7×10^{-4}	13000			
		9.2×10^{-4}	13580			
		9.2×10^{-3}	15180			

Material	T(°F)	$\dot{\varepsilon}$(/sec)	σ_Y(psi)	Elong. (%)	Ref.	Remarks
		9.2×10^{-2}	16000			
	50	1.5×10^{-4}	10500			
		6.2×10^{-4}	11350			
		6.2×10^{-3}	12500			
		6.2×10^{-2}	13580			
	107.6	2.6×10^{-4}	6300			
		1.24×10^{-3}	7000			
		1.24×10^{-2}	8500			
		1.24×10^{-1}	10000			
	122	2.5×10^{-4}	5000			
		4.2×10^{-3}	6300			
		5.8×10^{-2}	7050			
	131	1.5×10^{-3}	2960			
		1.5×10^{-2}	4500			
		1.5×10^{-1}	4530			
	140	5.8×10^{-5}	1000			
		5.8×10^{-4}	2500			
		5.8×10^{-2}	3600			
	149	1.3×10^{-2}	430			
		1.5×10^{-1}	1930			
PVC	room	8.3×10^{-1}	10500	20.3	P-2	Strain Rate-speed/
		8.33×10^{1}	14130		Tension	jaw separation average value
PVC (Rigid)	room	2.7×10^{-3}	7300	200	W-1	Read from (σ_Y,
		6.7×10^{-3}	8130	53	Tension	ε) curves
		2.7×10^{-2}	9460	26		Type I rigid PVC
		1.7×10^{-1}	11500	17		extruded into 2½ in. SDR 26 pipe
		1.6×10^{0}	13470	20.5		
		1.68×10^{1}	15700	21		
		1×10^{2}	17570	20		
PVC	room	2.7×10^{-3}	4630			Type II PVC Material
		6.7×10^{-3}	5380			from 2½ DSR 26 pipe
		2.7×10^{-2}	6300	100		
		1.7×10^{-1}	7670	60		
		1.6	9200	54		
		1.68×10^{1}	10800	56		
		1×10^{2}	12100	59		

Material	T(°F)	$\dot{\varepsilon}$(/sec)	σ_Y(psi)	Elong. (%)	Ref.	Remarks
PVC	room	2.7×10^{-3}	6900	230		PVC Type "1½" impact modified "1½" material
		6.7×10^{-3}	7600	88		
		2.7×10^{-2}	8700	41		
		1.7×10^{-1}	10300	26		
		1.64×10^{0}	12170	27		
		1.68×10^{1}	14030	32		
		1×10^{2}	15380	31		
PVC	room	2.7×10^{-3}	7780	123		Type I was designed as a specialty compound for pipe application
		6.7×10^{-3}	8780	66		
		2.7×10^{-2}	10080	33		
		1.7×10^{-1}	11940	23		
		1.6×10^{0}	14200	25		
		1.68×10^{1}	16500	27		
		1×10^{2}	18380	30		
PVC	-34.6	1×10^{-4}	15760		Z-1 Tension	Read from (σ_Y, $\dot{\varepsilon}$) curves (Halvic 239)
		3.5×10^{-4}	16260			
		3.5×10^{-3}	17620			
		4×10^{-2}	19570			
	3.2	8×10^{-5}	12980			
		5×10^{-4}	13600			
		5×10^{-3}	14840			
		5×10^{-2}	16000			
	50	1.2×10^{-4}	6030			
		8×10^{-4}	7110			
		8.5×10^{-3}	8390			
		8.5×10^{-2}	9830			
	107.6	1.2×10^{-4}	6030			
		8.5×10^{-4}	7260			
		8×10^{-3}	8440			
		5×10^{-2}	9890			
	122	8×10^{-5}	4020			
		3.5×10^{-4}	5100			
		3.5×10^{-3}	6380			
		3.5×10^{-2}	7200			
	131	9×10^{-5}	2530			
		3.5×10^{-4}	2830			

Material	T(°F)	$\dot{\varepsilon}$(/sec)	σ_Y(psi)	Elong. (%)	Ref.	Remarks
		2.5×10^{-3}	4640			
		4×10^{-2}	4580			
	140	1.2×10^{-4}	310			
		8×10^{-4}	960			
		7×10^{-3}	2320			
		7×10^{-2}	3760			
	149	3×10^{-3}	370			
		3×10^{-2}	1440			

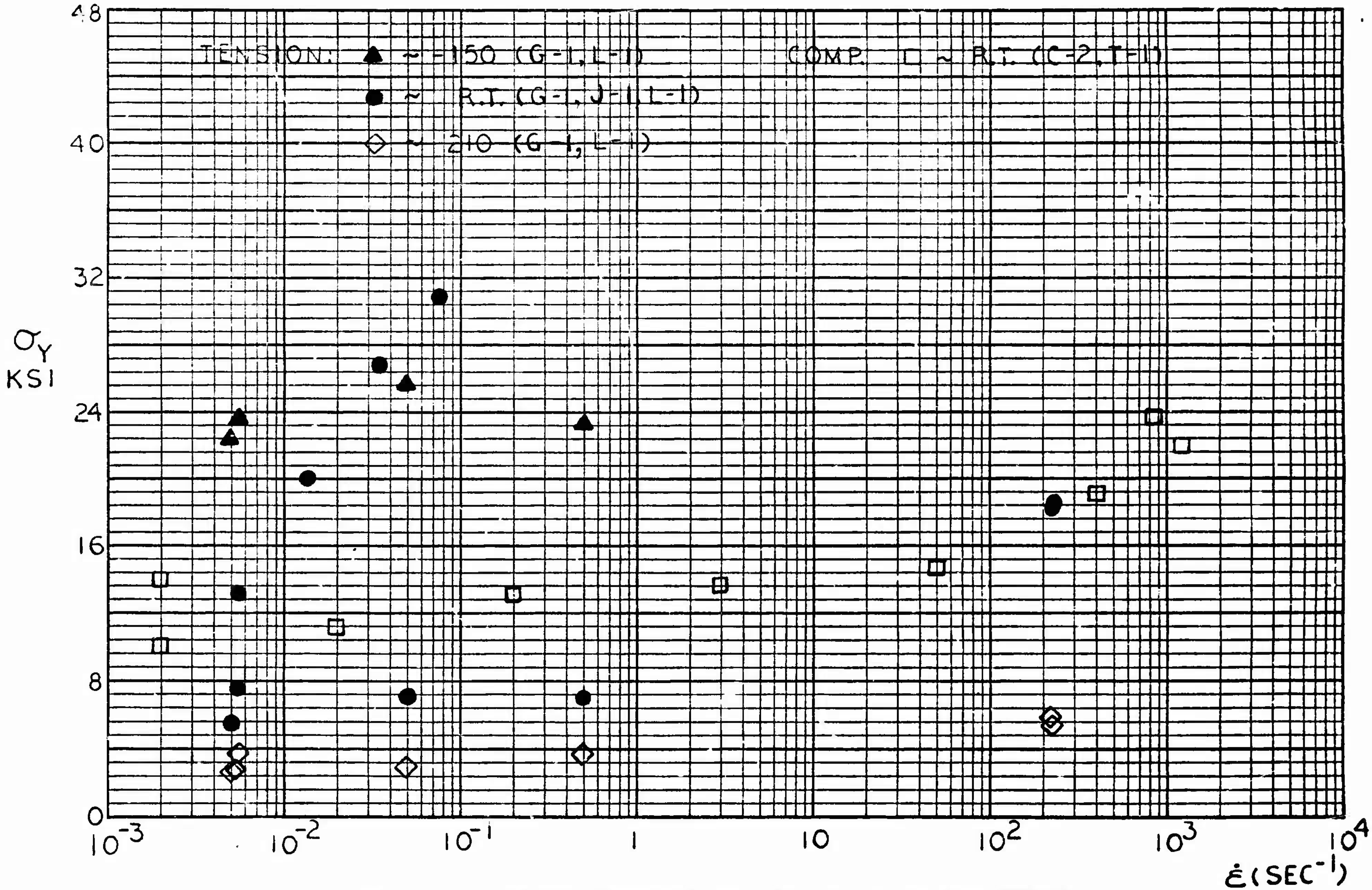

Fig. 1 Yield Strength vs. Strain Rate for NYLON

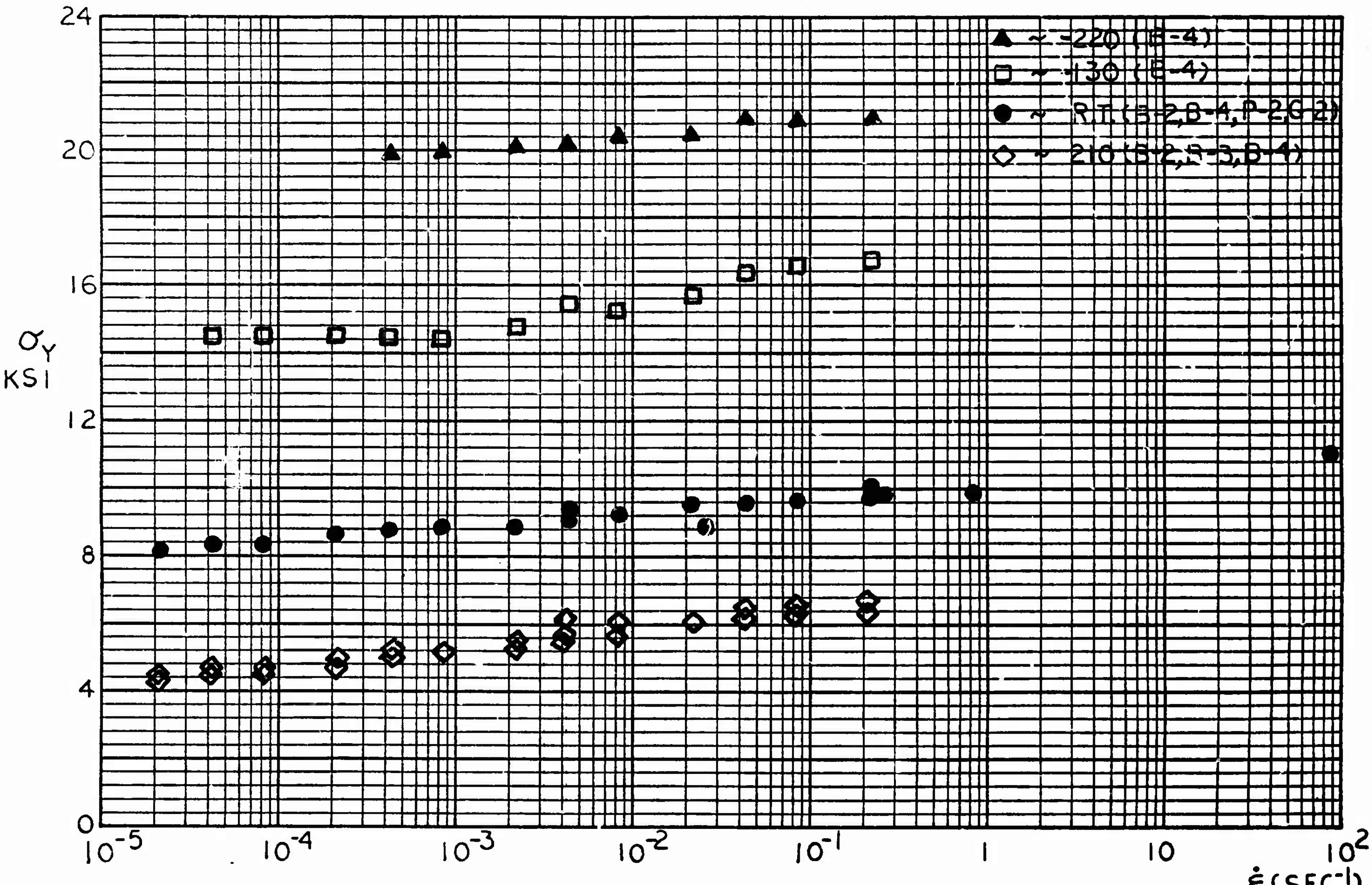

Fig. 2 Yield Strength vs. Strain Rate for Polycarbonate in Tension

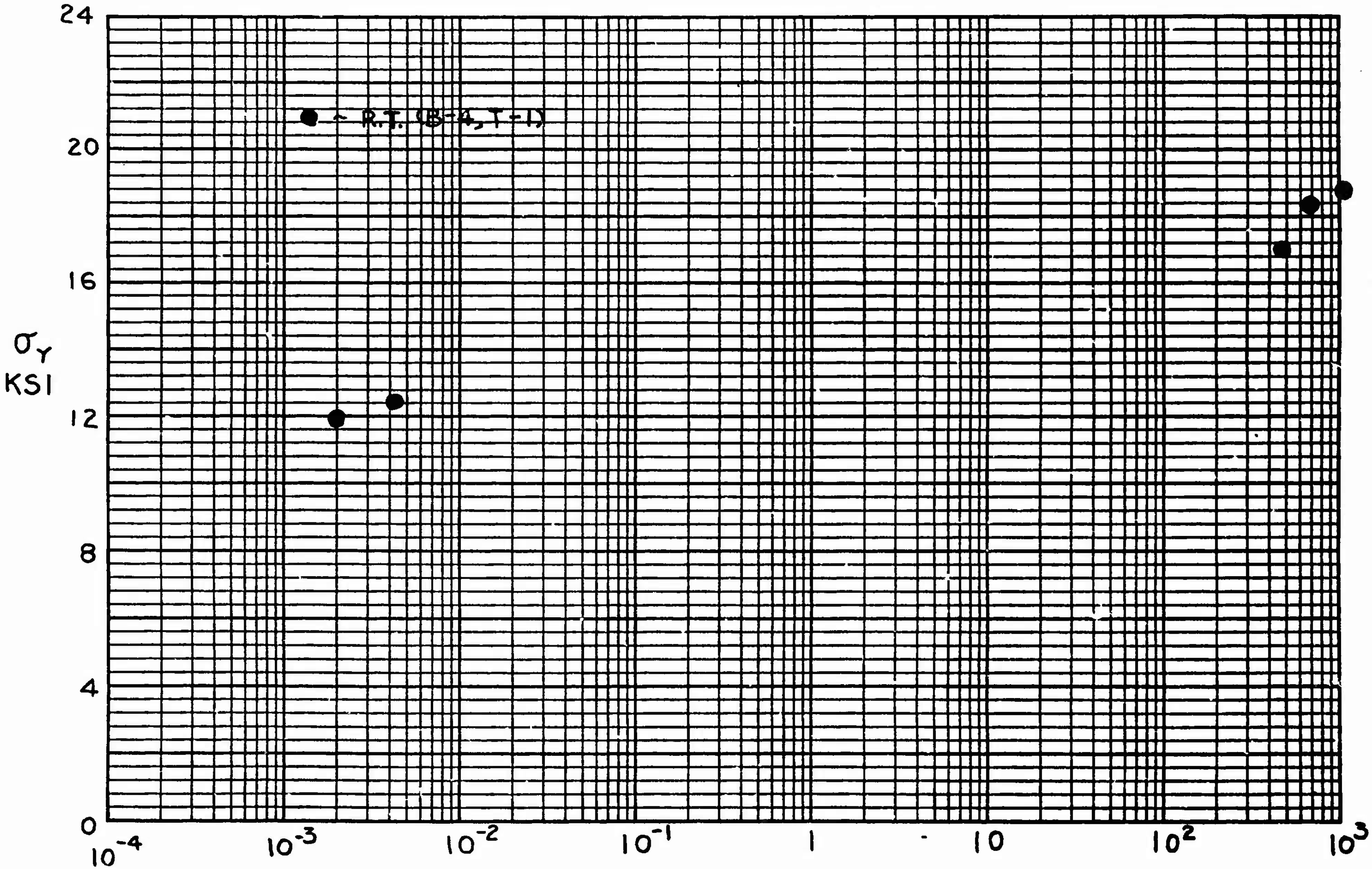

Fig. 3 Yield Strength vs. Strain Rate for Polycarbonate in Compression $\dot{\varepsilon}\,(SEC^{-1})$

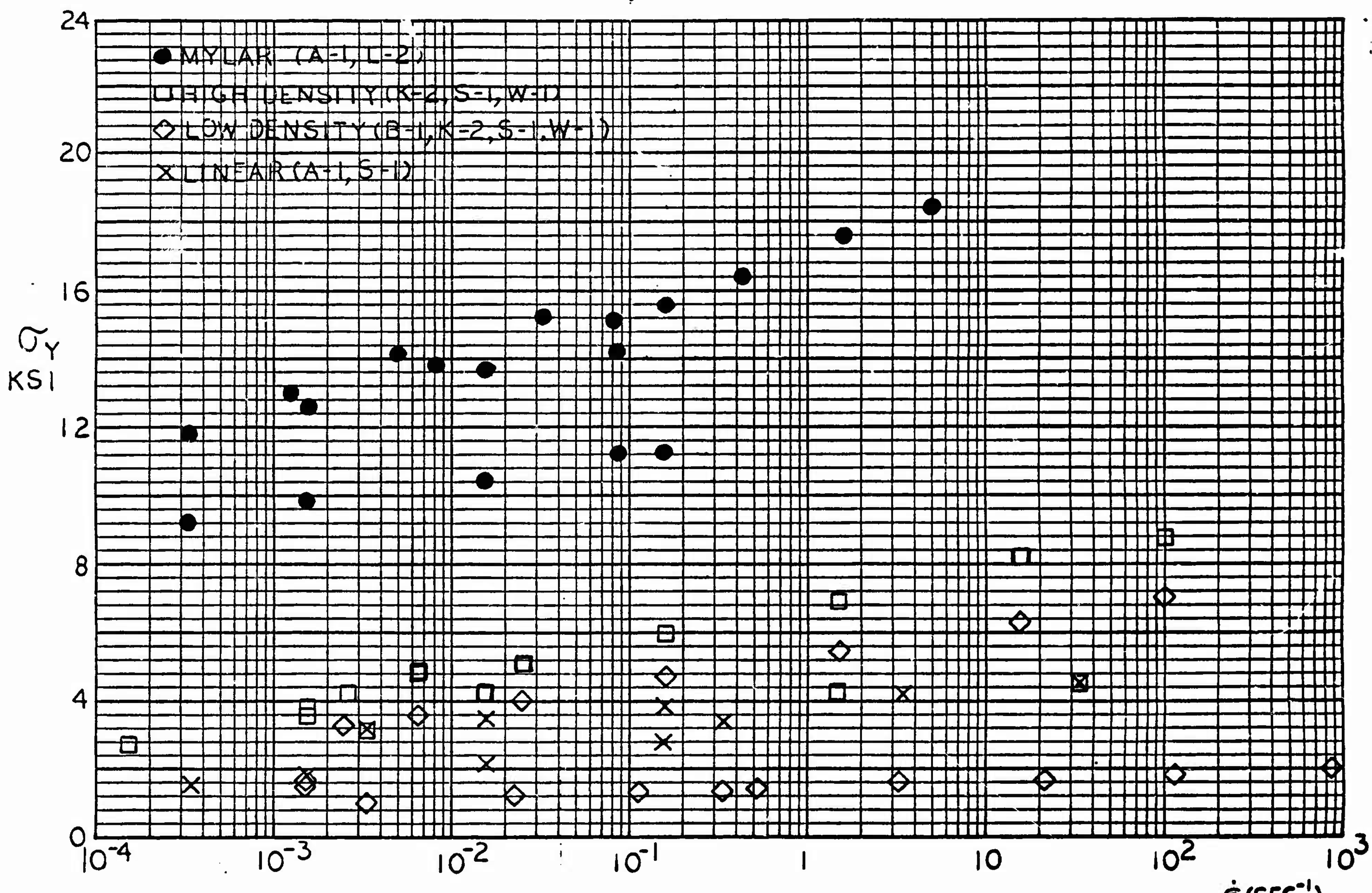

Fig. 4 Yield Strength vs. Strain Rate at Room Temperature for Polyethylene in Tension

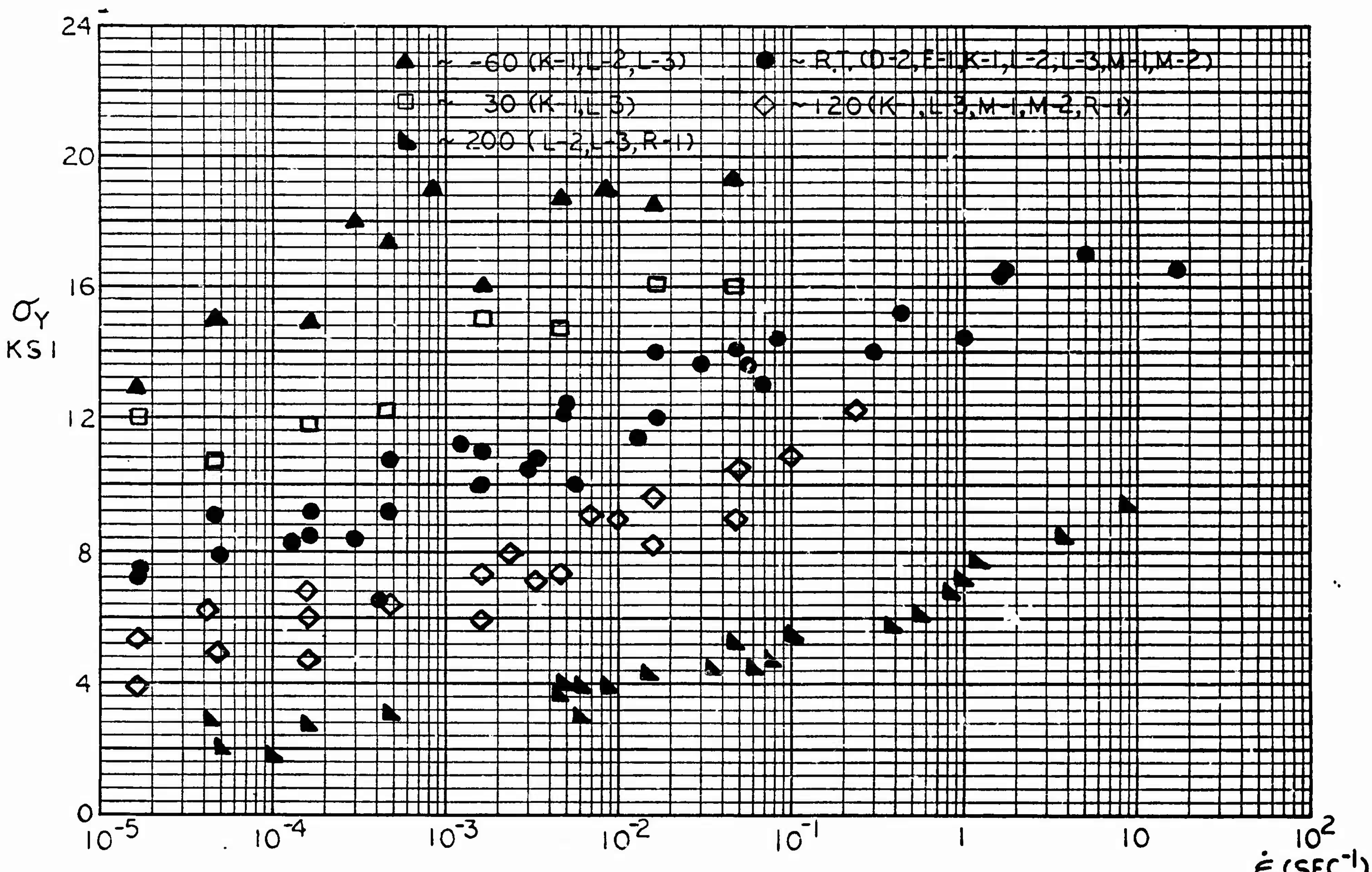

FIG. 5 Yield Strength vs. Strain Rate for Polymethyl Methacrylate in Tension

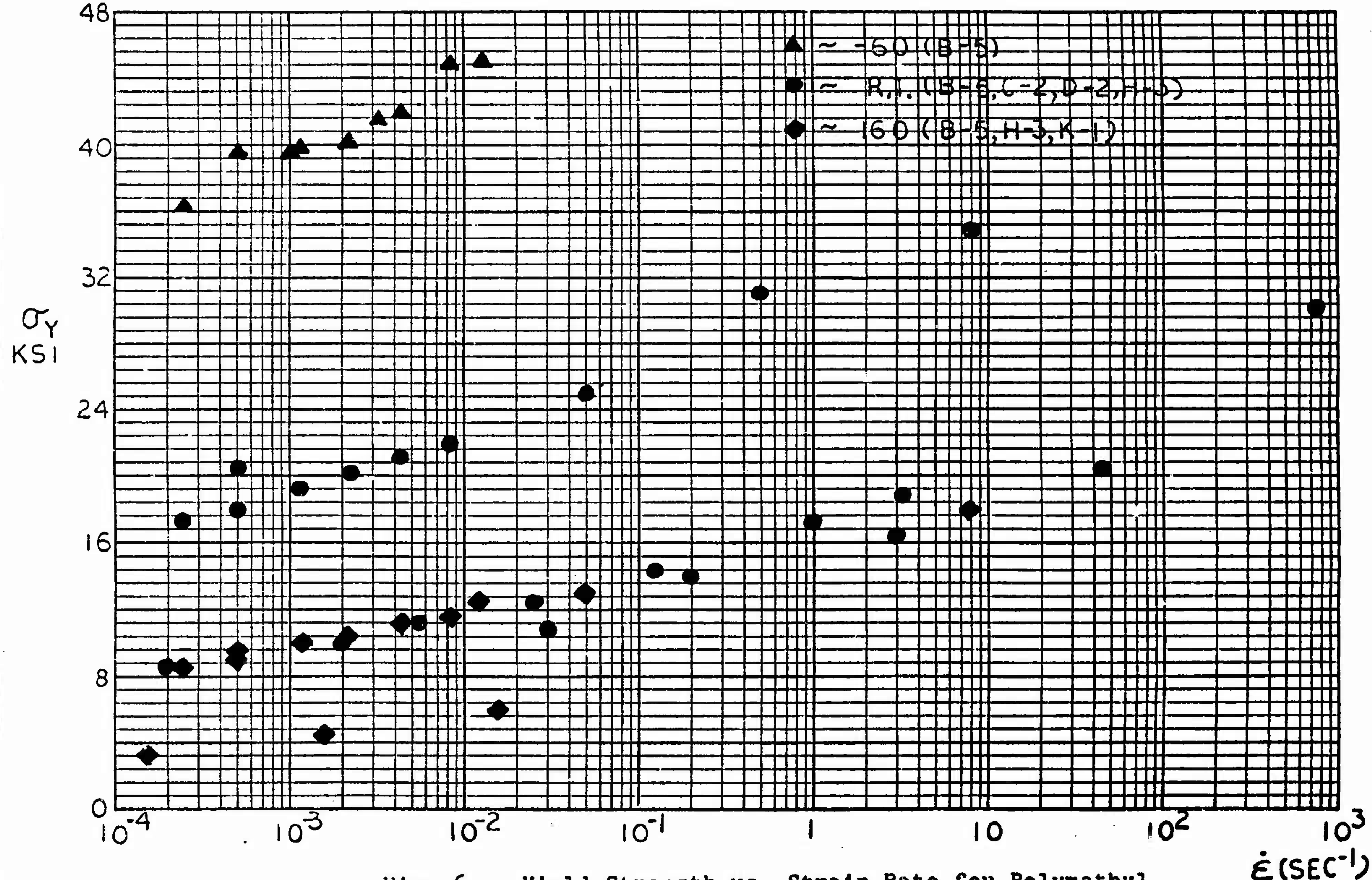

Fig. 6 Yield Strength vs. Strain Rate for Polymethyl Methacrylate in Compression

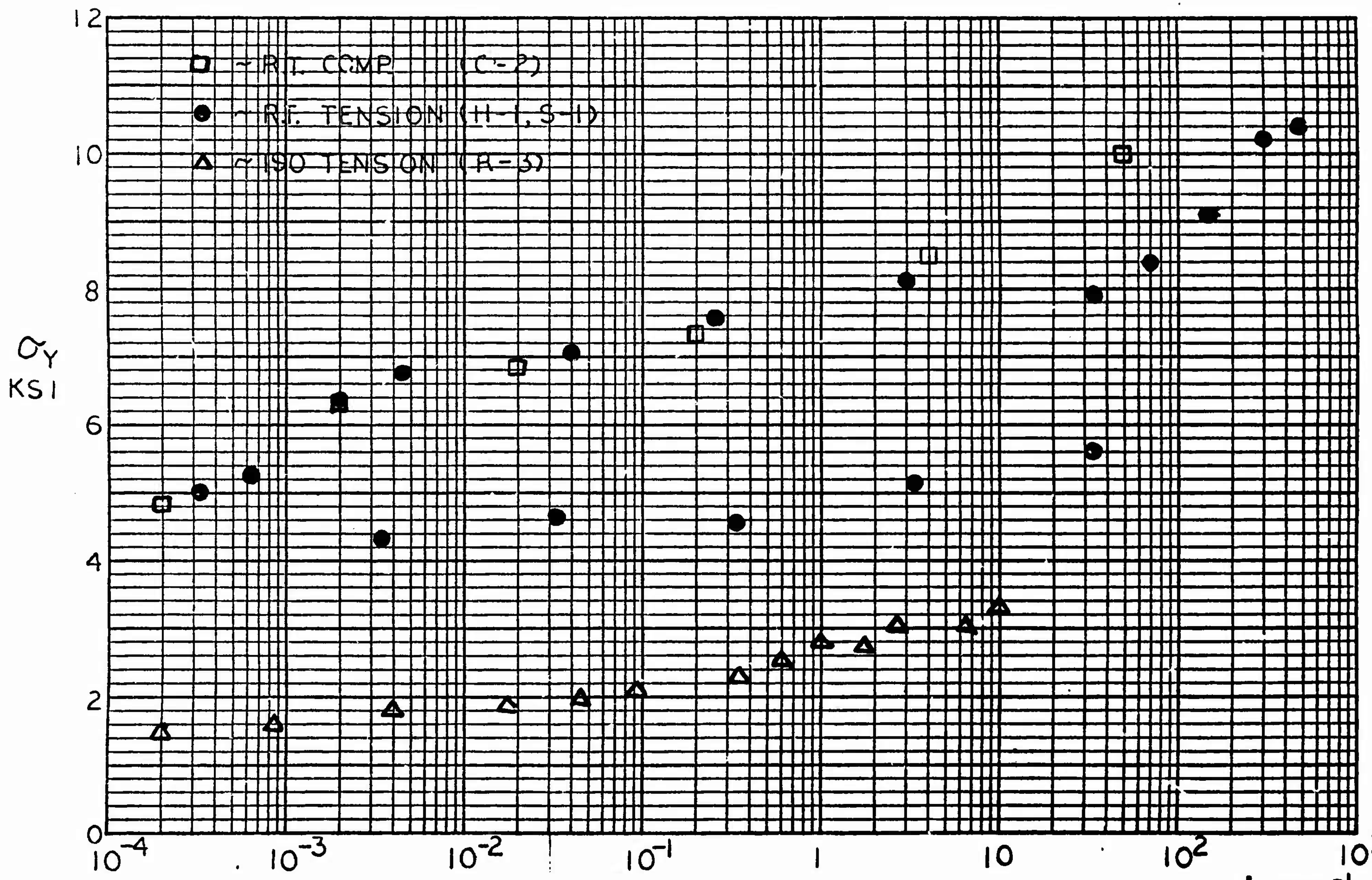

Fig. 7 Yield Strength vs. Strain Rate for Polypropylene

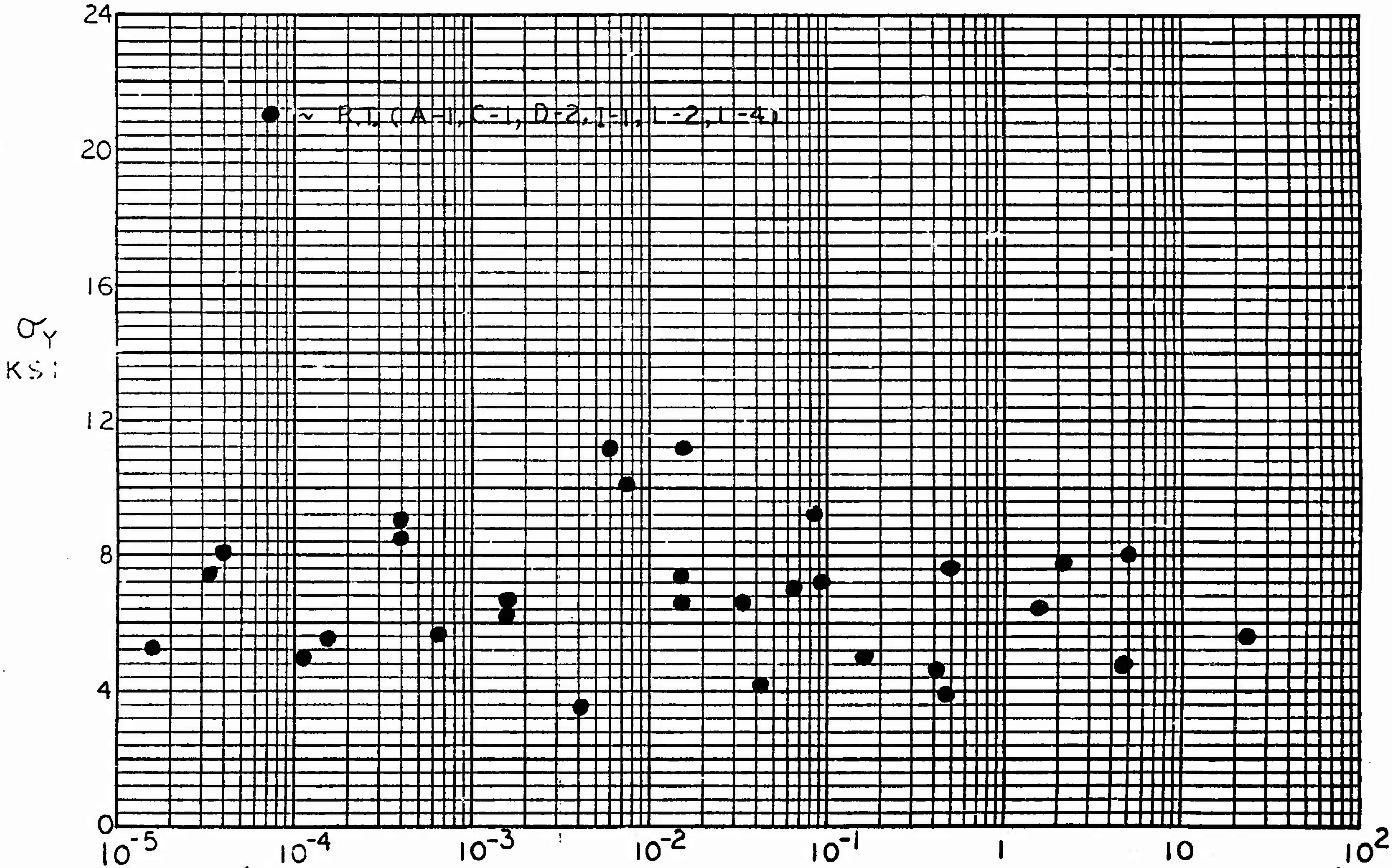

Fig. 8 Yield Strength vs. Strain Rate for Polystyrene in Tension

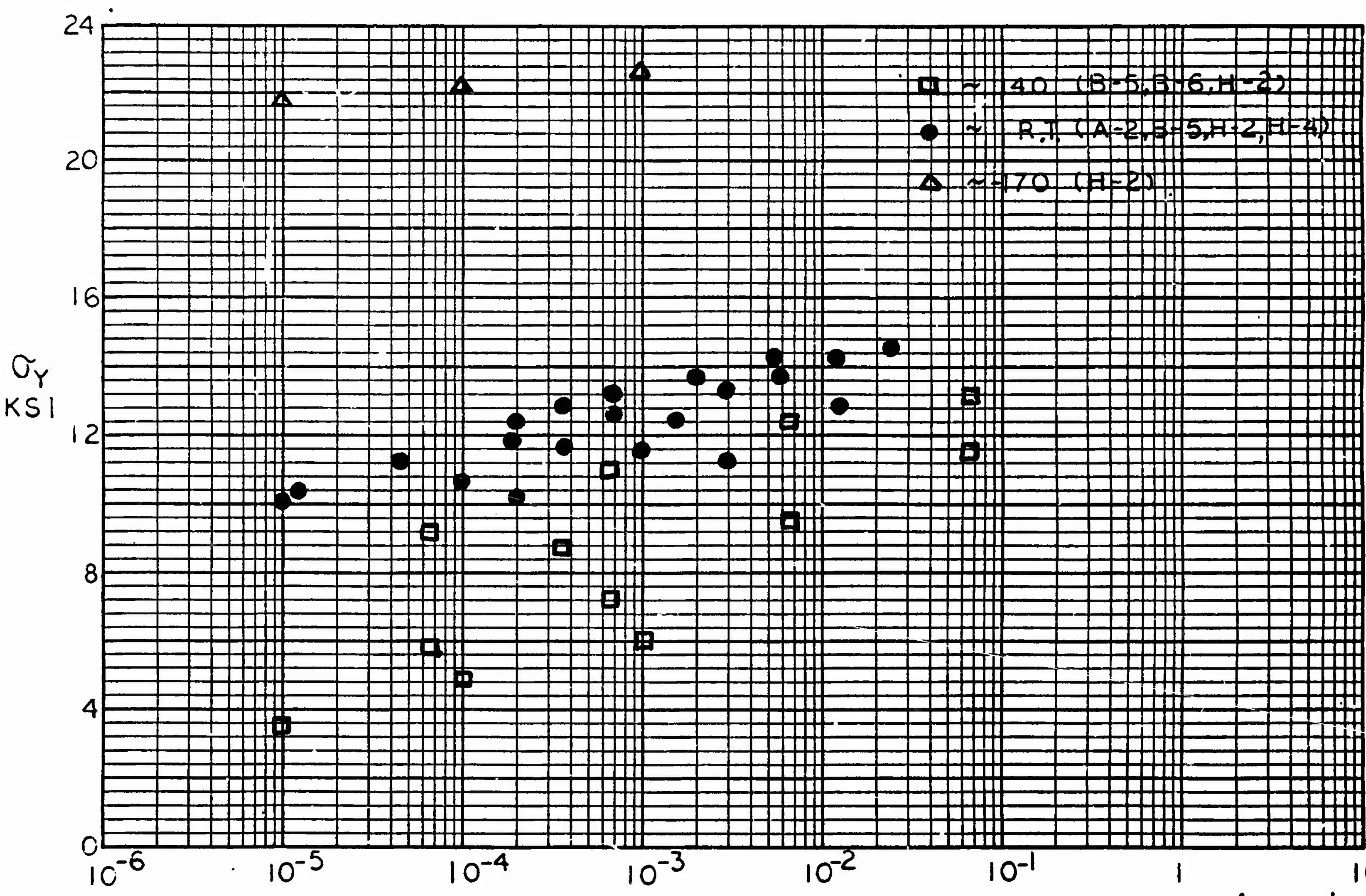

Fig. 9 Yield Strength vs. Strain Rate for Polystyrene in Compression

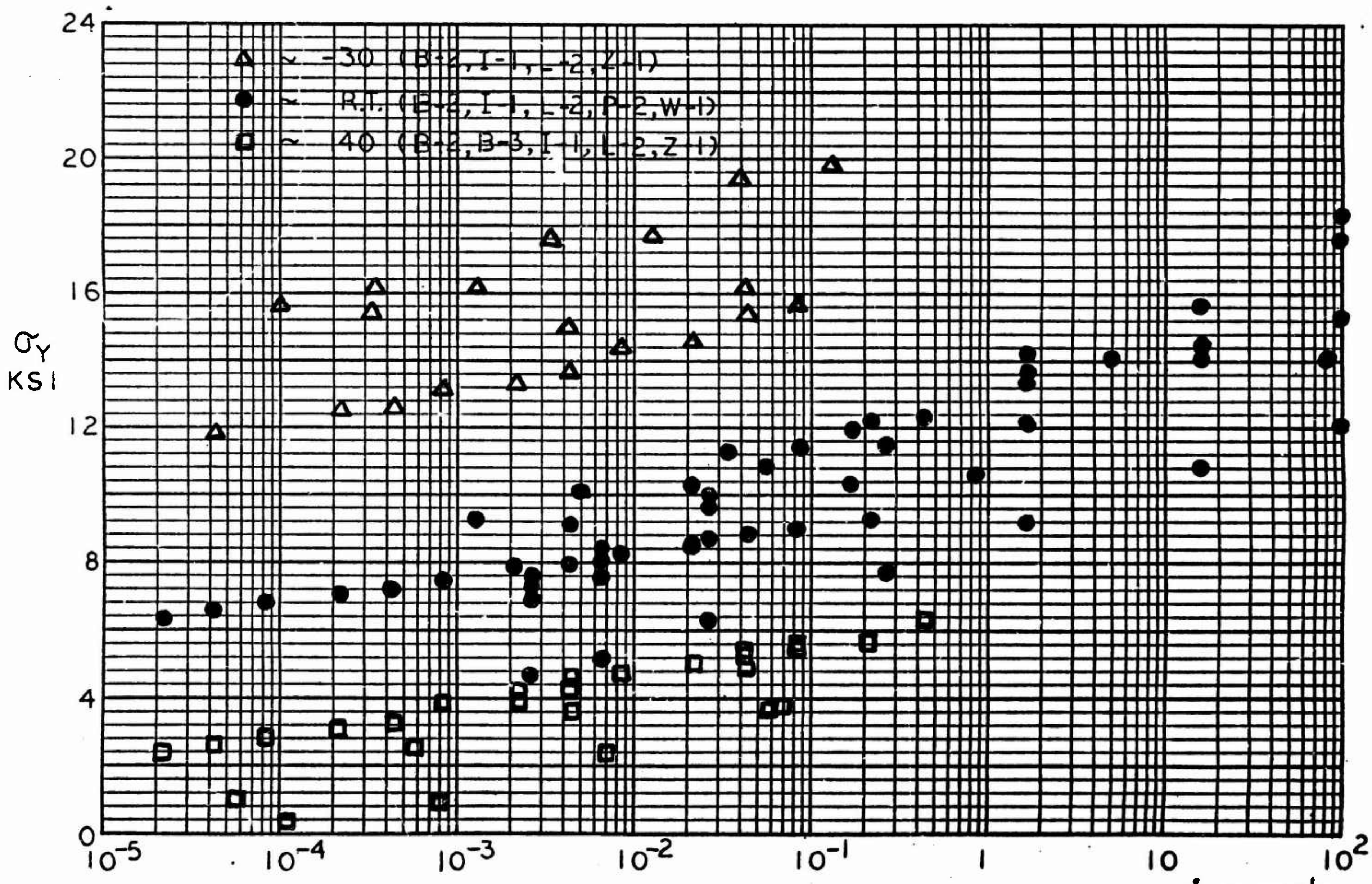

Fig. 10 Yield Strength vs. Strain Rate for Polyvinylchloride in Tension

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